Metolachlor
Analysis of Risks
to
Endangered and Threatened Salmon and Steelhead

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Summary

Metolachlor is a broad-spectrum chloroacetanilide herbicide that controls grasses, grass-like weeds, and broadleaved weeds in field corn, cotton, potatoes, and pod crops. A Reregistration Eligibility Decision (RED) that included an ecological risk assessment for nontarget fish and wildlife was issued in April of 1995. Metolachlor is slightly to moderately toxic to freshwater and estuarine animals but is not likely to occur in surface waters in high enough concentrations to directly impact listed Pacific salmon and steelhead. Although much uncertainty exists as to possible indirect effects, metolachlor has sufficient toxicity to aquatic vascular plants that listed Pacific salmon and steelhead might be indirectly affected by loss of cover in some spawning and rearing ESUs where metolachlor use is high. Because migration corridors consist of larger, faster-flowing streams, impacts on aquatic-plant cover seem unlikely during migration. We conclude that metolachlor will have no effect on six ESUs, may affect 15 ESUs, and may affect, but not likely to adversely affect, five ESUs. These determinations are based on the extent of crop acreage potentially treated in counties within an ESU, possible adverse effects of metolachlor on vascular aquatic-plant cover, and the phase-out of metolachlor in California.

Problem Formulation: The purpose of this analysis is to determine whether the registration of metolachlor as an herbicide for use on various crops may affect threatened and endangered (T&E or listed) Pacific anadromous salmon and steelhead and their designated critical habitat.

Scope: Although this analysis is specific to listed Pacific anadromous salmon and steelhead and the watersheds in which they occur, it is acknowledged that metolachlor is registered for uses that may occur outside this geographic scope and that additional analyses may be required to address other T&E species in the Pacific states as well as across the United States. I understand that any subsequent analyses, requests for consultation and resulting Biological Opinions may necessitate that Biological Opinions relative to this request be revisited, and could be modified.

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1. Background

Under section 7 of the Endangered Species Act, the Office of Pesticide Programs (OPP) of the U. S. Environmental Protection Agency (EPA) is required to consult on actions that 'may affect' Federally listed endangered or threatened species or that may adversely modify designated critical habitat. Situations where a pesticide may affect a fish, such as any of the salmonid species listed by the National Marine Fisheries Service (NMFS), include either direct or indirect effects on the fish. Direct effects result from exposure to a pesticide at levels that may cause harm.

Acute Toxicity - Relevant acute data are derived from standardized toxicity tests with lethality as the primary endpoint. These tests are conducted with what is generally accepted as the most sensitive life stage of fish, i.e., very young fish from 0.5-5 grams in weight, and with species that are usually among the most sensitive. These tests for pesticide registration include analysis of observable sublethal effects as well. The intent of acute tests is to statistically derive a median effect level; typically the effect is lethality in fish (LC50) or immobility in aquatic invertebrates (EC50). Typically, a standard fish acute test will include concentrations that cause no mortality, and often no observable sublethal effects, as well as concentrations that would cause 100% mortality. By looking at the effects at various test concentrations, a dose-response curve can be derived, and one can statistically predict the effects likely to occur at various pesticide concentrations; a well done test can even be extrapolated, with caution, to concentrations below those tested (or above the test concentrations if the highest concentration did not produce 100% mortality).

OPP typically uses qualitative descriptors to describe different levels of acute toxicity, the most likely kind of effect of modern pesticides (Table 1). These are widely used for comparative purposes, but must be associated with exposure before any conclusions can be drawn with respect to risk. Pesticides that are considered highly toxic or very highly toxic are required to have a label statement indicating that level of toxicity. The FIFRA regulations [40CFR158.490(a)] do not require calculating a specific LC50 or EC50 for pesticides that are practically non-toxic; the LC50 or EC50 would simply be expressed as >100 ppm. When no lethal or sublethal effects are observed at 100 ppm, OPP considers the pesticide will have "no effect" on the species.

Table 1. Qualitative descriptors for categories of fish and aquatic invertebrate toxicity (from Zucker, 1985)

LC50 or EC50	Category description
< 0.1 ppm	Very highly toxic
0.1- 1 ppm	Highly toxic
>1 < 10 ppm	Moderately toxic
> 10 < 100 ppm	Slightly toxic
> 100 ppm	Practically non-toxic

Comparative toxicology has demonstrated that various species of scaled fish generally have equivalent sensitivity, within an order of magnitude, to other species of scaled fish tested under the same conditions. Sappington et al. (2001), Beyers et al. (1994) and Dwyer et al. (1999), among others, have shown that endangered and threatened fish tested to date are similarly sensitive, on an acute basis, to a variety of pesticides and other chemicals as their non-endangered counterparts.

Chronic Toxicity - OPP evaluates the potential chronic effects of a pesticide on the basis of several types of tests. These tests are often required for registration, but not always. If a pesticide has essentially no acute toxicity at relevant concentrations, or if it degrades very rapidly in water, or if the nature of the use is such that the pesticide will not reach water, then chronic fish tests may not be required [40CFR158.490]. Chronic fish tests primarily evaluate the potential for reproductive effects and effects on the offspring. Other observed sublethal effects are also required to be reported. An abbreviated chronic test, the fish early-life stage test, is usually the first chronic test conducted and will indicate the likelihood of reproductive or chronic effects at relevant concentrations. If such effects are found, then a full fish life-cycle test will be conducted. If the nature of the chemical is such that reproductive effects are expected, the abbreviated test may be skipped in favor of the full life-cycle test. These chronic tests are designed to determine a "no observable effect level" (NOEL) and a "lowest observable effect level" (LOEL). A chronic risk requires not only chronic toxicity, but also chronic exposure, which can result from a chemical being persistent and resident in an environment (e.g., a pond) for a chronic period of time or from repeated applications that transport into any environment such that exposure would be considered "chronic".

As with comparative toxicology efforts relative to sensitivity for acute effects, EPA, in conjunction with the U. S. Geological Survey, has a current effort to assess the comparative toxicology for chronic effects also. Preliminary information indicates, as with the acute data, that endangered and threatened fish are again of similar sensitivity to similar non-endangered species.

Metabolites and Degradates - Information must be reported to OPP regarding any pesticide metabolites or degradates that may pose a toxicological risk or that may persist in the environment [40CFR159.179]. Toxicity and/or persistence test data on such compounds may be required if, during the risk assessment, the nature of the metabolite or degradate and the amount that may occur in the environment raises a concern. If actual data or structure-activity analyses are not available, the requirement for testing is based upon best professional judgement.

Inert Ingredients - OPP does take into account the potential effects of what used to be termed "inert" ingredients, but which are beginning to be referred to as "other ingredients". OPP has classified these ingredients into several categories. A few of these, such as nonylphenol, can no longer be used without including them on the label with a specific statement indicating the potential toxicity. Based upon our internal databases, we can find no product in which nonylphenol is now an ingredient. Many others, including such ingredients as clay, soybean oil, many polymers, and chlorophyll, have been evaluated through structure-activity analysis or data and determined to be of minimal or no toxicity. There exist also two additional lists, one for inerts with potential toxicity which are considered a testing priority, and one for inerts unlikely to be toxic, but which cannot yet be said to have negligible toxicity. Any new inert ingredients are required to undergo testing unless it can be demonstrated that testing is unnecessary.

The inerts efforts in OPP are oriented only towards toxicity at the present time, rather than risk. It should be noted, however, that very many of the inerts are in exceedingly small amounts in pesticide products. While some surfactants, solvents, and other ingredients may be present in fairly large amounts in various products, many are present only to a minor extent. These include such things as coloring agents, fragrances, and even the printers ink on water soluble bags of pesticides. Some of these could have moderate toxicity, yet still be of no consequence because of the negligible amounts present in a product. If a product contains inert ingredients in sufficient quantity to be of concern, relative to the toxicity of the active ingredient, OPP attempts to evaluate the potential effects of these inerts through data or structure-activity analysis, where necessary.

For a number of major pesticide products, testing has been conducted on the formulated end-use products that are used by the applicator. The results of fish toxicity tests with formulated products can be compared with the results of tests on the same species with the active ingredient only. A comparison of the results should indicate comparable sensitivity, relative to the percentage of active ingredient in the technical versus formulated product, if there is no extra activity due to the combination of inert ingredients. We note that the “comparable” sensitivity must take into account the natural variation in toxicity tests, which is up to 2-fold for the same species in the same laboratory under the same conditions, and which can be somewhat higher between different laboratories, especially when different stocks of test fish are used.

The comparison of formulated product and technical ingredient test results may not provide specific information on the individual inert ingredients, but rather is like a “black box” which sums up the effects of all ingredients. We consider this approach to be more appropriate than testing each individual inert and active ingredient because it incorporates any additivity, antagonism, and synergism effects that may occur and which might not be correctly evaluated from tests on the individual ingredients. We do note, however, that we do not have aquatic data on most formulated products, although we often have testing on one or perhaps two formulations of an active ingredient.

Risk - An analysis of toxicity, whether acute or chronic, lethal or sublethal, must be combined with an analysis of how much will be in the water, to determine risks to fish. Risk is a combination of exposure and toxicity. Even a very highly toxic chemical will not pose a risk if there is no exposure, or very minimal exposure relative to the toxicity. OPP uses a variety of chemical fate and transport data to develop “estimated environmental concentrations” (EECs) from a suite of established models. The development of aquatic EECs is a tiered process.

The first tier screening model for EECs is with the GENEEC program, developed within OPP, which uses a generic site (in Yazoo, MS) to stand for any site in the U. S. The site choice was intended to yield a maximum exposure, or “worst-case,” scenario applicable nationwide, particularly with respect to runoff. The model is based on a 10 hectare watershed that surrounds a one hectare pond, two meters deep. It is assumed that all of the 10 hectare area is treated with the pesticide and that any runoff would drain into the pond. The model also incorporates spray drift, the amount of which is dependent primarily upon the droplet size of the spray. OPP assumes that if this model indicates no concerns when compared with the appropriate toxicity data, then further analysis is not necessary as there would be no effect on the species.

It should be noted that prior to the development of the GENEEC model in 1995, a much more crude approach was used to determining EECs. Older reviews and Reregistration Eligibility Decisions (REDs) may use this approach, but it was excessively conservative and does not provide a sound basis for modern risk assessments. For the purposes of endangered species consultations, we will attempt to revise this old approach with the GENEEC model, where the old screening level raised risk concerns.

When there is a concern with the comparison of toxicity with the EECs identified in GENEEC model, a more sophisticated PRZM-EXAMS model is run to refine the EECs if a suitable scenario has been developed and validated. The PRZM-EXAMS model was developed with widespread collaboration and review by chemical fate and transport experts, soil scientists, and agronomists throughout academia, government, and industry, where it is in common use. As with the GENEEC model, the basic model remains as a 10 hectare field surrounding and draining into a 1 hectare pond. Crop scenarios have been developed by OPP for specific sites, and the model uses site-specific data on soils, climate (especially precipitation), and the crop or site. Typically, site-scenarios are developed to provide for a worst-case analysis for a particular crop in a particular geographic region. The development of site scenarios is very time consuming; scenarios have not yet been developed for a number of crops and locations. OPP attempts to match the crop(s) under consideration with the most appropriate scenario. For some of the older OPP analyses, a very limited number of scenarios were available.

One area of significant weakness in modeling EECs relates to residential uses, especially by homeowners, but also to an extent by commercial applicators. There are no usage data in OPP that relate to pesticide use by homeowners on a geographic scale that would be appropriate for an assessment of risks to listed species. For example, we may know the maximum application rate for a lawn pesticide, but we do not know the size of the lawns, the proportion of the area in lawns, or the percentage of lawns that may be treated in a given geographic area. There is limited information on soil types, slopes, watering practices, and other aspects that relate to transport and fate of pesticides. We do know that some homeowners will attempt to control pests with chemicals and that others will not control pests at all or will use non-chemical methods. We would expect that in some areas, few homeowners will use pesticides, but in other areas, a high percentage could. As a result, OPP has insufficient information to develop a scenario or address the extent of pesticide use in a residential area.

It is, however, quite necessary to address the potential that home and garden pesticides may have to affect T&E species, even in the absence of reliable data. Therefore, we have developed a hypothetical scenario, by adapting an existing scenario, to address pesticide use on home lawns where it is most likely that residential pesticides will be used outdoors. It is exceedingly important to note that there is no quantitative, scientifically valid support for this modified scenario; rather it is based on my best professional judgement. We do note that the original scenario, based on golf course use, does have a sound technical basis, and the home lawn scenario is effectively the same as the golf course scenario. Three approaches will be used. First, the treatment of fairways, greens, and tees will represent situations where a high proportion of homeowners may use a pesticide. Second, we will use a 10% treatment to represent situations where only some homeowners may use a pesticide. Even if OPP cannot reliably determine the percentage of homeowners using a pesticide in a given area, this will provide two estimates. Third, where the risks from lawn use could exceed our criteria by only a modest amount, we can back-calculate the percentage of land that would need to be treated to exceed our criteria. If a smaller percentage is treated, this would then be below our criteria of concern. The percentage here would be not just of lawns, but of all of the treatable area under consideration; but in urban and highly populated suburban areas, it would be similar to a percentage of lawns. Should reliable data or other information become available, the approach will be altered appropriately.

It is also important to note that pesticides used in urban areas can be expected to transport considerable distances if they should run off on to concrete or asphalt, such as with streets (e.g., TDK Environmental, 1991). This makes any quantitative analysis very difficult to address aquatic exposure from home use. It also indicates that a no-use or no-spray buffer approach for protection, which we consider quite viable for agricultural areas, may not be particularly useful for urban areas.

Finally, the applicability of the overall EEC scenario, i.e., the 10 hectare watershed draining into a one hectare farm pond, may not be appropriate for a number of T&E species living in rivers or lakes. This scenario is intended to provide a "worst-case" assessment of EECs, but very many T&E fish do not live in ponds, and very many T&E fish do not have all of the habitat surrounding their environment treated with a pesticide. OPP does believe that the EECs from the farm pond model do represent first order streams, such as those in headwaters areas (Effland, et al. 1999). In many agricultural areas, those first order streams may be upstream from pesticide use, but in other areas, or for some non-agricultural uses such as forestry, the first order streams may receive pesticide runoff and drift. However, larger streams and lakes will very likely have lower, often considerably lower, concentrations of pesticides due to more dilution by the receiving waters. In addition, where persistence is a factor, streams will tend to carry pesticides away from where they enter into the streams, and the models do not allow for this. The variables in size of streams, rivers, and lakes, along with flow rates in the lotic waters and seasonal variation, are large enough to preclude the development of applicable models to represent the diversity of T&E species' habitats. We can simply qualitatively note that the farm pond model is expected to overestimate EECs in larger bodies of water.

Indirect Effects - We also attempt to protect listed species from indirect effects of pesticides. We note that there is often not a clear distinction between indirect effects on a listed species and adverse modification of critical habitat (discussed below). By considering indirect effects first, we can provide appropriate protection to listed species even where critical habitat has not been designated. In the case of fish, the indirect concerns are routinely assessed for food and cover.

The primary indirect effect of concern would be for the food source for listed fish. These are best represented by potential effects on aquatic invertebrates, although aquatic plants or plankton may be relevant food sources for some fish species. However, it is not necessary to protect individual organisms that serve as food for listed fish. Thus, our goal is to ensure that pesticides will not impair populations of these aquatic arthropods. In some cases, listed fish may feed on other fish. Because our criteria for protecting the listed fish species is based upon the most sensitive species of fish tested, then by protecting the listed fish species, we are also protecting the species used as prey.

In general, but with some exceptions, pesticides applied in terrestrial environments will not affect the plant material in the water that provides aquatic cover for listed fish. Application rates for herbicides are intended to be efficacious, but are not intended to be excessive. Because only a portion of the effective application rate of an herbicide applied to land will reach water through runoff or drift, the amount is very likely to be below effect levels for aquatic plants. Some of the applied herbicides will degrade through photolysis, hydrolysis, or other processes. In addition, terrestrial herbicide applications are efficacious in part, due to the fact that the product will tend to stay in contact with the foliage or the roots and/or germinating plant parts, when soil applied. With aquatic exposures resulting from terrestrial applications, the pesticide is not placed in immediate contact with the aquatic plant, but rather reaches the plant indirectly after entering the water and being diluted. Aquatic exposure is likely to be transient in flowing waters. However, because of the exceptions where terrestrially applied herbicides could have effects on aquatic plants, OPP does evaluate the sensitivity of aquatic macrophytes to these herbicides to determine if populations of aquatic macrophytes that would serve as cover for T&E fish would be affected.

For most pesticides applied to terrestrial environment, the effects in water, even lentic water, will be relatively transient. Therefore, it is only with very persistent pesticides that any effects would be expected to last into the year following their application. As a result, and excepting those very persistent pesticides, we would not expect that pesticidal modification of the food and cover aspects of critical habitat would be adverse beyond the year of application. Therefore, if a listed salmon or steelhead is not present during the year of application, there would be no concern. If the listed fish is present during the year of application, the effects on food and cover are considered as indirect effects on the fish, rather than as adverse modification of critical habitat.

Designated Critical Habitat - OPP is also required to consult if a pesticide may adversely modify designated critical habitat. In addition to the indirect effects on the fish, we consider that the use of pesticides on land could have such an effect on the critical habitat of aquatic species in a few circumstances. For example, use of herbicides in riparian areas could affect riparian vegetation, especially woody riparian vegetation, which possibly could be an indirect effect on a listed fish. However, there are very few pesticides that are registered for use on riparian vegetation, and the specific uses that may be of concern have to be analyzed on a pesticide by pesticide basis. In considering the general effects that could occur and that could be a problem for listed salmonids, the primary concern would be for the destruction of vegetation near the stream, particularly vegetation that provides cover or temperature control, or that contributes woody debris to the aquatic environment. Destruction of low growing herbaceous material would be a concern if that destruction resulted in excessive sediment loads getting into the stream, but such increased sediment loads are insignificant from cultivated fields relative to those resulting from the initial cultivation itself. Increased sediment loads from destruction of vegetation could be a concern in uncultivated areas. Any increased pesticide load as a result of destruction of terrestrial herbaceous vegetation would be considered a direct effect and would be addressed through the modeling of estimated environmental concentrations. Such modeling can and does take into account the presence and nature of riparian vegetation on pesticide transport to a body of water.

Risk Assessment Processes - All of our risk assessment procedures, toxicity test methods, and EEC models have been peer-reviewed by OPP's Science Advisory Panel. The data from toxicity tests and environmental fate and transport studies undergo a stringent review and validation process in accordance with "Standard Evaluation Procedures" published for each type of test. In addition, all test data on toxicity or environmental fate and transport are conducted in accordance with Good Laboratory Practice (GLP) regulations (40 CFR Part 160) at least since the GLPs were promulgated in 1989.

The risk assessment process is described in "Hazard Evaluation Division - Standard Evaluation Procedure - Ecological Risk Assessment" by Urban and Cook (1986) (termed Ecological Risk Assessment SEP below), which has been separately provided to National Marine Fisheries Service staff. Although certain aspects and procedures have been updated throughout the years, the basic process and criteria still apply. In a very brief summary: the toxicity information for various taxonomic groups of species is quantitatively compared with the potential exposure information from the different uses and application rates and methods. A risk quotient of toxicity divided by exposure is developed and compared with criteria of concern. The criteria of concern presented by Urban and Cook (1986) are presented in Table 2.

Table 2. Risk quotient criteria for fish and aquatic invertebrates

Test data	Risk quotient	Presumption
Acute LC50	>0.5	Potentially high acute risk
Acute LC50	>0.1	Risk that may be mitigated through restricted use classification
Acute LC50	>0.05	Endangered species may be affected acutely, including sublethal effects
Chronic NOEC	>1	Chronic risk; endangered species may be affected chronically, including reproduction and effects on progeny
Acute invertebrate LC50	>0.5	May be indirect effects on T&E fish through food supply reduction
Aquatic plant acute EC50	>0.5	May be indirect effects on aquatic vegetative cover for T&E fish

The Ecological Risk Assessment SEP (pages 2-6) discusses the quantitative estimates of how the acute toxicity data, in combination with the slope of the dose-response curve, can be used to predict the percentage mortality that would occur at the various risk quotients. The discussion indicates that using a "safety factor" of 10, as applies for restricted use classification, one individual in 30,000,000 exposed to the concentration would be likely to die. Using a “safety factor” of 20, as applies to aquatic T&E species, would exponentially increase the margin of safety. It has been calculated by one pesticide registrant (without sufficient information for OPP to validate that number), that the probability of mortality occurring when the LC50 is 1/20th of the EEC is 2.39×10^{-9}, or less than one individual in ten billion. It should be noted that the discussion (originally part of the 1975 regulations for FIFRA) is based upon slopes of primarily organochlorine pesticides, stated to be 4.5 probits per log cycle at that time. As organochlorine pesticides were phased out, OPP undertook an analysis of more current pesticides based on data reported by Johnson and Finley (1980), and determined that the “typical” slope for aquatic toxicity tests for the “more current” pesticides was 9.95. Because the slopes are based upon logarithmically transformed data, the probability of mortality for a pesticide with a 9.95 slope is again exponentially less than for the originally analyzed slope of 4.5.

The above discussion focuses on mortality from acute toxicity. OPP is concerned about other direct effects as well. For chronic and reproductive effects, our criteria ensures that the EEC is below the no-observed-effect-level, where the “effects” include any observable sublethal effects. Because our EEC values are based upon “worst-case” chemical fate and transport data and a small farm pond scenario, it is rare that a non-target organism would be exposed to such concentrations over a period of time, especially for fish that live in lakes or in streams (best professional judgement). Thus, there is no additional safety factor used for the no-observed-effect-concentration, in contrast to the acute data where a safety factor is warranted because the endpoints are a median probability rather than no effect.

Sublethal Effects - With respect to sublethal effects, Tucker and Leitzke (1979) did an extensive review of existing ecotoxicological data on pesticides. Among their findings was that sublethal effects as reported in the literature did not occur at concentrations below one-fourth to one-sixth of the lethal concentrations, when taking into account the same percentages or numbers affected, test system, duration, species, and other factors. This was termed the “6x hypothesis”. Their review included cholinesterase inhibition, but was largely oriented towards externally observable parameters such as growth, food consumption, behavioral signs of intoxication, avoidance and repellency, and similar parameters. Even reproductive parameters fit into the hypothesis when the duration of the test was considered. This hypothesis supported the use of lethality tests for use in assessing ecotoxicological risk, and the lethality tests are well enough established and understood to provide strong statistical confidence, which can not always be achieved with sublethal effects. By providing an appropriate safety factor, the concentrations found in lethality tests can therefore generally be used to protect from sublethal effects.

In recent years, Moore and Waring (1996) challenged Atlantic salmon with diazinon and observed effects on olfaction as relates to reproductive physiology and behavior. Their work indicated that diazinon could have sublethal effects of concern for salmon reproduction. However, the nature of their test system, direct exposure of olfactory rosettes, could not be quantitatively related to exposures in the natural environment. Subsequently, Scholz et al.

(2000) conducted a non-reproductive behavioral study using whole Chinook salmon in a model stream system that mimicked a natural exposure that is far more relevant to ecological risk assessment than the system used by Moore and Waring (1996). The Scholz et al. (2000) data indicate potential effects of diazinon on Chinook salmon behavior at very low levels, with statistically significant effects at nominal diazinon exposures of 1 ppb, with apparent, but non-significant effects at 0.1 ppb.

It would appear that the Scholz et al (2000) work contradicts the 6x hypothesis. The research design, especially the nature and duration of exposure, of the test system used by Scholz et al (2000), along with a lack of dose-response, precludes comparisons with lethal levels in accordance with 6x hypothesis as used by Tucker and Leitzke (1979). Nevertheless, it is known that olfaction is an exquisitely sensitive sense. And this sense may be particularly well developed in salmon, as would be consistent with its use by salmon in homing (Hasler and Scholz, 1983). So the contradiction of the 6x hypothesis is not surprising. As a result of these findings, the 6x hypothesis needs to be re-evaluated with respect to olfaction. At the same time, because of the sensitivity of olfaction and because the 6x hypothesis has generally stood the test of time otherwise, it would be premature to abandon the hypothesis for other sublethal effects until there are additional data.

2. Description and use of metolachlor

Metolachlor is a broad-spectrum chloroacetanilide herbicide that controls grasses, grass-like weeds, and broadleaved weeds by interfering with cell division and inhibiting seedling development and shoot growth. Crops treated with metolachlor include field corn, cotton, pod crops (garbanzo, beans, lima beans, peas), soybeans, and potatoes. However, as of December 31, 1999, the state of California canceled all use of metolachlor products in that state. Currently, nine metolachlor products, including three technicals and six end-use products (70-86.4% emulsifiable concentrates), are registered for use in states other than California. Two products containing 79.9% metolachlor also contain either 2.1% or 2.6% flumetsulam as an additional active ingredient. Another product containing 70% metolachlor also contains 15% metribuzin as an active ingredient. Metribuzin will be assessed in more detail in a subsequent consultation. Risks posed by s-metolachlor, the stereoisomer of racemic metolachlor and also an active ingredient in other pesticide products, also will be addressed in a later assessment and are not considered here.

Relevant metolachlor use sites, application methods, and rates of application for this consultation are summarized below. Additional use directions, restrictions, and precautions can be found on the attached product labels.

- Field Corn: Application can be made only by ground in a broadcast spray or banded treatment. Metolachlor can be applied preplant (must be incorporated into the soil), preemergence (during or after planting but only before weeds or crop emerge), or at the spike stage (from corn emergence up to 2 inches in height but before weeds emerge). Application rates range from 1.75 to 2.50 pints of product (2.33 lb ai metolachlor and 0.0625 lb ai flumetsulam) per acre, with the highest rate used on fine soils. No more than 2.75 pints of product can be applied per acre per year.

- Potatoes: Applications can be made pre- or postemergence and up to twice per year, but the amount of product applied cannot exceed 5 ½ pints (4.5 lb ai metolachlor and 1.0 lb ai metribuzin) per acre per year. Preemergence application can be made after planting but before crop emerges by air, by ground-spray equipment (except air blast sprayers), or in sprinkler irrigation water. The application rate is 2 to 4 pints product per acre, depending on organic matter content and soil texture. Postemergence application is only by sprinkler irrigation at a rate of 2 to 2 2/3 pints product per acre, depending on soil texture. Metolachlor also may be tank mixed with other herbicides registered for use on potatoes.

- Pod crops: Application can be made preplant incorporated or preemergence at up to 1.95 lb ai/acre, and may be applied by ground or air.

Nationwide usage of metolachlor from 1998 to 2000 is presented in Table 3 for the major use sites. Average metolachlor usage was about 34 million pounds of active ingredient per year, but usage began to decline in 1998 when s-metolachlor was introduced into the market as a new active ingredient. Idaho and Oregon are among the states with the highest usage of metolachlor on potatoes. We have also attached a map of pesticide use for metolachlor as developed by the USGS. This map is included as a quick and easy visual depiction of where metolachlor may have been used on agricultural crops, but it should not be used for any quantitative analysis because it is based on 1992 crop acreage data and was developed from 1990-1995 statewide estimates of use that were then applied to that county acreage without consideration of local practices and usage.

Usage information for California in 2000 and 2001 is reported separately in Table 4. Corn, cotton, and beans were the major uses in both years, but the acreage treated and the total amount used declined markedly from 2000 to 2001. Because metolachlor products are not currently registered for use in California, applications in 2000 and 2001 presumably were made under an existing stocks provision for the phase-out of metolachlor in California. No usage information is yet available for 2002, but usage can be expected to continue to decline as existing stocks are depleted.

Table 3. Nationwide Use of Metolachlor from 1998-2000. Values are weighted averages; the most recent years and more reliable data are weighted more heavily (source OPP/BEAD Quantitative Usage Analysis for Metolachlor, 2002)

Site	Acres grown	Acres treated	% crop treated	lb ai applied	States with most usage in 2000
Corn	76,292,000	14,058,000	18	23,871,000	IL, IN, IA, KS, NE
Soybeans	71,431,000	2,766,000	4	4,854,000	AR, IA, MS, OH
Sorghum	7,158,000	1,809,000	25	2,481,000	KS, LA, ME, TX
Peanuts	1,453,000	306,000	21	554,000	GA, NC, SC, TX, VA
Cotton	13,798,000	485,000	4	514,000	CA, MS, MO, TX
Potatoes	1,282,000	227,000	18	401,000	ID, CA, OR, WI
Dry beans/ Peas	2,029,000	144,000	7	218,000	CA, KS, MI, MN
Others		417,640		779,360	
Total		20,212,640		33,672,360	

Table 4. Usage of metolachlor in California in 2000 and 2001 (source: CA Pesticide Use Report; http://www.cdpr.ca.gov/docs/pur/purmain.htm**)**

Use site	2000		2001	
	Acres treated	lb ai applied	Acres treated	lb ai applied
Corn	19,232	40,178	3,295	9,446
Cotton	29,433	60,458	5,391	8,289
Beans	19,425	35,529	2,764	4,712
Outdoor flowers	496	936	819	1,320
Peas	216	359	204	277
Potato	1,082	1,863	1	1
Others	nr[a]	3,382	nr[a]	755
Total		145,305		24,800

[a] acreage treated is not reported for some noncrop uses

a. Aquatic toxicity of metolachlor

The acute toxicity data for freshwater organisms indicate that metolachlor is slightly to moderately toxic to freshwater fish and invertebrates (Table 5). Tests on an emulsifiable concentrate indicate that this test material has comparable toxicity to technical metolachlor; therefore, the inert ingredients in that formulation do not appear to enhance the toxicity of the active ingredient. Only one additional study was found in the literature to further characterize the toxicity of metolachlor to aquatic invertebrates (Table 6). No additional toxicity data were found for fish.

Table 5. Aquatic organisms: acute toxicity of metolachlor to freshwater fish and invertebrates (source: EFED toxicity database)

Species	Scientific name	% ai	LC50 or EC50[a] (ppm)	Toxicity Category
Rainbow trout	*Oncorhynchus mykiss*	technical	3.9	moderately toxic
Rainbow trout		95	48	slightly toxic
Bluegill sunfish	*Lepomis macrochirus*	technical	10	moderately toxic
Fathead minnow	*Pimephales promelas*	95.4	8.0	moderately toxic
Fathead minnow		87 (EC)[b]	8.4	moderately toxic
Carp	*Carassius carassius*	technical	4.9	moderately toxic
Channel catfish	*Ictalarus punctatus*	technical	4.9	moderately toxic
Guppy	*Poecilia reticulata*	technical	8.6	moderately toxic
Water flea	*Daphnia magna*	technical	25.1	slightly toxic
Water flea		95.4	23.5	slightly toxic
Water flea		95	>108	practically nontoxic
Water flea		87 (EC)[b]	26	slightly toxic
Midge	*Chironomus plumosus*	95.4	3.8	moderately toxic
Midge		87 (EC)[b]	4.4	moderately toxic

[a] 96-hour LC50 for fish and 48-hour EC50 for the water flea
[b] material tested was an emulsifiable concentrate

Table 6. Aquatic organisms: acute toxicity of metolachlor to freshwater invertebrates (source: literature)

Species	Scientific name	48-hour EC50 (ppm)	Reference
Water flea	*Ceriodaphnia dubia*	15.9	Ort et al. 1994[a]

[a] data obtained from ECOTOX (USEPA/ORD/NHEERL Ecotoxicology Database: http://www.epa.gov/ecotox/; see "References" section for a full citation of each study)

Adverse chronic effects on reproduction or growth of freshwater fish and invertebrates occurred at exposure concentrations of 1.6 to 6.9 ppm (Table 7). Test organisms in these studies were exposed to the test material for extended periods (21 or 35 days).

Table 7. Aquatic organisms: chronic toxicity of metolachlor to freshwater fish and invertebrates (source: EFED toxicity database)

Species	Scientific name	test duration (days)	% ai	Endpoints affected	NOEC (ppm)	LOEC (ppm)
Water flea	*Daphnia magna*	21	97	growth	3.2	6.9
Fathead minnow	*Pimephales promelas*	35	97.4	reproduction	0.8	1.6

The acute toxicity of metolachlor to estuarine fish and invertebrates (Table 8) is similar to that for freshwater fish and invertebrates. Adverse chronic effects on survival and growth of an estuarine fish, the sheepshead minnow, occurred at an exposure concentrations of 2.2 ppm (Table 9), which is comparable to that for the freshwater fathead minnow.

Table 8. Aquatic organisms: acute toxicity of metolachlor to estuarine fish and invertebrates (source: EFED toxicity database)

Species	Scientific name	% ai	LC50 or EC50[a] (ppm)	Toxicity Category
Sheepshead minnow	*Cyprinodon variegatus*	97	7.9	moderately toxic
Sheepshead minnow		97.3	9.8	moderately toxic
Mysid shrimp	*Mysidopsis bahia*	97.3	4.9	moderately toxic
Eastern oyster	*Crassostrea virginica*	97.3	1.6	moderately toxic

[a] 96-hour LC50 for fish or EC50 for invertebrates

Table 9. Aquatic organisms: chronic toxicity of metolachlor to estuarine fish (source: EFED toxicity database)

Species	Scientific name	test duration (days)	% ai	Endpoints affected	NOEC (ppm)	LOEC (ppm)
Sheepshead minnow	*Cyprinodon variegatus*	26	97	survival and growth	1.0	2.2

The available OPP toxicity data indicate that metolachlor is highly toxic to vascular (duckweed) and nonvascular (algae, diatoms) aquatic plants (Table 10). Additional data from the literature that further characterize the toxicity of metolachlor are provided in Table 11. These data indicate that toxicity to vascular aquatic species is somewhat less when the exposure period is reduced from 14 to 4 days, suggesting that even briefer exposure in flowing waters might be less toxic.

Table 10. Aquatic organisms: toxicity of metolachlor to algae and aquatic plants (source: EFED toxicity database)[a]

Species	Scientific name	% ai	120-h EC50 (ppm)
Green algae	*Selanastrum capricornutum*	97.3	0.01
Blue-green algae	*Anabaena flos-aquae*	97.3	1.20
Diatom	*Navicula pelliculosa*	97.3	0.38
Diatom	*Skeletonema costatum*	97.3	0.06
Duckweed	*Lemna gibba*	97.3	0.05 (14 days)

[a] these data were submitted as a requirement of reregistration

Table 11. Aquatic organisms: additional data to characterize acute toxicity of metolachlor to algae and aquatic plants (source: literature[a])

Species	Scientific name	96-hour EC50 (ppm)	Reference
Green algae	*Selanastrum capricornutum*	0.05	St.Laurant and Blaise 1992
Green algae		0.05	St.Laurant and Blaise 1992
Blue-green algae	*Anabaena flos-aquae*	>3	Fairchild et al. 1998
Coon-tail	*Ceratophyllum demersum*	0.07 (14 days)	Fairchild et al. 1998
Green algae	*Chlorella vulgaris*	0.20	Fairchild et al. 1998
Green algae	*Chlorella reinhardtii*	1.14	Fairchild et al. 1998

Species	Scientific name	96-hour EC50 (ppm)	Reference
Green algae	*Chlorella fusca*	0.11 (12 days)	Kotrikla et al.1997
Water weed	*Elodea canadensis*	2.35 (14 days)	Fairchild et al. 1998
Duckweed	*Lemna minor*	0.34	Fairchild et al. 1997
Duckweed		0.36	Fairchild et al. 1998

[a] data obtained from ECOTOX (USEPA/ORD/NHEERL Ecotoxicology Database: http://www.epa.gov/ecotox/; see "References" section for a full citation of each study)

b. Environmental fate and transport

The available information indicate that metolachlor appears to be moderately persistent to persistent in the environment. Degradation appears to be dependent on microbially mediated processes (aerobic soil metabolism $t_{1/2}$ = 13.9 to 66 days; anaerobic soil metabolism $t_{1/2}$ = 81 days) and abiotic processes (photodegradation $t_{1/2}$ under natural sunlight = 70 days in water and 8 days on soil). Depending on the soil characteristics, metolachlor has the potential to range from a moderately mobile to a highly mobile material, with K_d values ranging from 0.11 to 44.8 and Koc values ranging from 21.6 to 367 (mean K_{oc} = 249.25). Major degradates are CGA-51202 (metolachlor OA), CGA-50720, CGA-41638, CGA-37735, CGA-13656, and CGA-354743 (metolachlor ESA); of these degradates, both metolachlor ESA and metolachlor OA have been found in surface and groundwater.

We are not aware of any toxicity testing in which aquatic organisms have been exposed to these degradates. However, OPP's Health Effects Division has reviewed a series of acute, subchronic, developmental (rat) and mutagenicity studies conducted with CGA 354743 (ethane sulfonic acid metabolite of metolachlor and s-metolachlor) and CGA 51202 (oxanilic acid degradate), metabolites of metolachlor/s-metolachlor found in water. The available data appeared to indicate that the metabolites were less toxic than the parents metolachlor and s-metolachlor after repeated dosing based on subchronic studies in the rat and dog (CGA 354743 only) and developmental studies in the rat. No toxicity was observed in any of these studies with CGA 354743 or CGA 51202 at the limit dose of 1000 mg/kg/day or greater.

Field dissipation studies indicate that metolachlor is persistent in surface soil. Half-lives range from 7 days (Iowa) to 292 days (California) in the upper six-inch soil layer, depending on geographic location and total amount of water applied (17 to >40 inches) during the study. Metolachlor was reportedly detected as deep as the 36 to 48 inch soil-layer segment in some studies. The degradate CGA-51202 was detected (0.11 ppm) as deep as 30 to 36 inches in soil and CGA-40172, CGA-40172, and CGA-40919 as deep as 36 to 48 inches. CGA-50720 was not detected (LOD = 0.07 ppm) in any soil segment at any interval.

c. Incidents

OPP maintains two data bases of reported incidents. One, the (EFED Incident Information System or EIIS) is populated with information on environmental incidents which are provided voluntarily to OPP by state and federal agencies and others. There have been periodic solicitations for such information to the states and the U. S. Fish and Wildlife Service. The second is a compilation of incident information known to pesticide registrants and any data conducted by them that shows results differing from those contained in studies provided to support registration. These data and studies (together termed incidents) are required to be submitted to OPP under regulations implementing FIFRA section 6(a)(2). Not surprisingly for metolachlor, which is an herbicide, most incidents reported involved terrestrial plants. The EIIS incident database also contains five incidents in which fish reportedly died after exposure to runoff and drift from fields treated with metolachlor and atrazine or cyanazine. These incidents are summarized below.

> A fish kill (~100 bass and bream) occurred in a pond in South Carolina on March 31, 1984 that was attributed to runoff of metolachlor and atrazine from an adjacent corn field. The event occurred after a rainfall event of 4.2 inches. Metolachlor was detected at 28.3 ppb and atrazine at 19.8 ppb in the pond water.
>
> A fish kill in a Louisiana pond in 1997 occurred after heavy rains two days after application of metolachlor and atrazine to a nearby field. Metolachlor was detected in water samples at 14 to 57 ppb and atrazine at 32 to 116 ppb .
>
> A kill of ~300 bass and ~300 bluegills occurred in a pond in Delaware in 1997 following application of metolachlor, atrazine, and nitrogen fertilizer to a corn field. An algal bloom due to fertilizer runoff was a probable cause, but metolachlor and atrazine were detected in the pond at levels of 45 and 57 ppb, respectively.
>
> Two northern pike and ~5000 mud minnows died in a Minnesota creek in 1997 after metolachlor and cyanazine spilled from a truck and ran into the creek. Metolachlor was detected at levels of 2 to 178 ppb and cyanazine at 1.7 to 154 ppb.
>
> Runoff into pond from a treated corn field in Indiana was reported to have killed fish. No data were provided to corroborate that metolachlor was involved.

It seems a bit surprising that metolachlor would kill fish at the concentrations reported in these incidents, because toxicity tests indicate that the LC50 for fish ranges from 3.9 to 48 ppm (Table 5). How much, if any, degradation of metolachlor may have occurred before water samples were taken is not known. Fish mortality also might have been enhanced from exposure to multiple stressors. Atrazine was detected along with metolachlor in three incidents and cyanazine in another, and the combination of pesticides may have had additive or possibly even synergistic effects. Oxygen depletion due to an algal bloom from fertilizer runoff also may have been a factor in the fish mortality.

d. Estimated and actual concentrations of metolachlor in surface waters

Estimated environmental concentrations (EECs)

The RED provides estimated environmental concentrations (EECs) for several crops, based on deposition of metolachlor into standing surface waters ranging from 0.5-feet to 6-feet deep (Table 12). The RED does not state how the EECs were determined, but they appear to have been determined from a very simplistic approach used by OPP/EFED before current models were developed. Thus, there is considerable uncertainty as to their relevance to current application rates and methods for these use sites. Roadside rights-of-way is no longer a registered use, and current application rates for both corn (2.56 lb ai/acre) and potatoes (4.5 lb ai/acre) are less than those used to calculate EECs in the RED. Therefore, the EECs provided in the RED should be taken as a very conservative estimate for currently registered use sites and application rates and methods.

Table 12. Estimated Aquatic Concentrations (EECs) of Metolachlor in Surface Waters (source: RED). Some use sites have been canceled and some application rates have changed since the RED was issued.

Site	Appl. rate (lb ai/acre)	Water depth (ft)	EEC (ppm)
Corn, Potatoes, Peanuts, Alfalfa	6	6	0.19
Cotton, Cabbage, Pepper, Seed Radish	2	6	0.06
Roadsides (noncrop)	1.25	6	0.04
		1	0.23
		0.5	0.46

Because of the uncertainties of the EECs used to assess risk in the RED, and because incorporation was not considered for preplant applications, we have used GENEEC to model EECs for currently registered uses and application rates for metolachlor. Peak EECs for acute exposure and 60-day-average EECs for chronic exposure are determined for each crop based on the maximum application rate, application interval if more than one application is made, application method (air or ground and whether incorporated or not), and environmental fate aspects of metolachlor such as aerobic soil metabolism half-life (13.9 days), mean soil organic carbon-partition coefficient (249.25), photolytic half-life (70 days), and solubility in water (530 ppm.). Potato is the only crop that is treated with more than one application. Because an application interval is not specified on product labels, we assumed an interval of 15 days for modeling EECs from applications to potatoes. Moreover, aerial application can be made for the first application only, as the product labels specify that a second application can be made only via sprinkler irrigation water. Because GENEEC cannot model different application methods for multiple applications, our EECs for potatoes are based on two ground applications. Aquatic EECs and risk quotients for freshwater fish and vascular aquatic plants are presented in Table 13 for the currently registered uses of metolachlor. The risk quotients will be discussed further in section f. (General risk conclusions).

Table 13. Aquatic EECs and risk quotients for freshwater fish and vascular aquatic plants. EECs were modeled using GENEEC.

Site	Appl. rate (lb ai/acre)	Application method	Peak EEC (ppb)	Fish acute RQ[a]	Aquatic plant RQ[b]	60-day-avg EEC (ppb)	Fish chronic RQ[c]
Corn	2.33	aerial broadcast	95	0.02	1.9	64	<0.1
		ground broadcast	83	0.02	1.7	56	<0.1
		ground broadcast (incorporated 4")	22	<0.01	0.4	15	<0.1
		banded	83	0.02	1.7	55	<0.1
Potatoes	2.25 (2 appl.)[d]	ground	119	0.03	2.4	80	0.1
Pod crops	1.95	aerial broadcast	79	0.02	1.6	53	<0.1
		ground broadcast	70	0.02	1.4	47	<0.1
		ground broadcast (incorporated 4")	18	<0.01	0.4	12	<0.1

[a] based on the LC50 of 3900 ppb for the rainbow trout
[b] based on the EC50 of 50 ppb for duckweed
[c] based on the NOEC of 800 ppb for the fathead minnow
[d] an application interval is not specified on product labels; we assumed 15 days

The results of the screening model indicate that for corn and pod crops, comparable aquatic EECs result from broadcast application whether by air or by ground. However, when metolachlor is incorporated into the soil, which is required for preplant application on these crops, EECs are dramatically reduced. The highest EECs result from metolachlor use on potatoes, because the application rate per growing season is highest and applications are not incorporated. It should be noted that application to potatoes can be made twice per growing season. A preemergence application of 2 to 4 pints of product (1.64 to 3.27 lb ai) per acre can be broadcast by air or ground or applied via sprinkler-irrigation water. A second, postemergence application (2 to 2 2/3 pints product) can be made only via sprinkler-irrigation water, and the total of both applications cannot exceed 5.5 pints (4.5 lb ai) per acre per growing season.

Actual Concentrations in Water

Metolachlor is a common contaminant in water, and some monitoring data exist. As reported in the NAWQA database, metolachlor has been detected in surface water in 75% of 6623 samples from locations in 32 states. Annual maximum concentrations ranged from 0.002 to 77.6 ppb, with upper bound time-weighted means from 0.002 to 4.3 ppb. No degradate data are available. STORET data compiled by Heidelberg College in the 1980s from high metolachlor use areas in Michigan and Ohio provide annual maximum concentrations ranging from 0 to 138.76 ppb. Metolachlor data from 1995 also are available from the Acetochlor Registration Partnership, which examined community water supplies from 175 locations in 12 states. Annual maximum concentrations ranged from < 0.02 to 9.05 ppb.

e. Changes in registration status

Many use sites have been canceled since the RED was issued in 1995, and granular formulations are no longer registered. Food and feed crop use sites addressed in the RED included cabbage, peppers, radish, stone fruits, corn (field, pop, sweet), cotton, legume vegetables, peanuts, peas, potatoes, safflower, sorghum, soybeans, tree nuts, and alfalfa. Non-food crop sites addressed in the RED included rights-of-way, fence rows and hedge rows, airports and landing fields, Christmas tree plantations, commercial and industrial lawns, golf course turf, nonagricultural uncultivated areas and soils, ornamentals (trees, lawns and turf, woody shrubs, vines, herbaceous and nonflowering plants), recreation areas, nonbearing fruits (apples, cherries, citrus fruits, crabapples, grapes, pears), forest trees (softwoods, conifers), and residential lawns. Currently registered uses nationwide are cotton, corn, sorghum, soybeans, potatoes, dried and succulent beans, safflower, and peanuts. There are no homeowner uses.

f. General risk conclusions

The environmental risk assessment in the RED concluded that there are no likely acute or chronic effects to freshwater and estuarine fish and aquatic invertebrates, including endangered species, from registered uses of metolachlor. The only exception was for deposition of metolachlor into shallow (1-foot deep) standing waters along treated roadsides, for which the risk quotient (RQ = 0.12) exceeds the level of concern ($\geq$0.05) for endangered fish. However, listed Pacific salmon and steelhead are not likely to be found in such shallow standing waters that might receive a direct application of metolachlor. Rather, they are more likely to be exposed in waters that receive runoff and drift, not direct application. The level of concern was not exceeded for deeper (6-foot deep) standing waters along roadsides or for other registered uses, including corn and potatoes. Our calculations of aquatic EECs and risk quotients based on GENEEC modeling for current uses and application rates and methods indicates minimal acute and chronic risks to aquatic animals from any registered use of metolachlor (Table 13).

Metolachlor is highly toxic to vascular aquatic plants. The risk quotients in Table 13 exceed the level of concern for risk to aquatic plants for all currently registered use sites.

However, risk quotients vary by application method; when metolachlor is incorporated into the soil, EECs are sufficiently reduced that the level of concern is not exceeded. This is true for corn and pod crops, but incorporation is not used for any application to potatoes. Where incorporation is feasible on any crop, it should be considered as a possible mitigation measure. Mandating a buffer to minimize runoff and drift into surface waters also should be considered. Nevertheless, there is much uncertainty as to whether potential adverse effects to aquatic plants are likely to be severe enough to affect cover of listed Pacific salmon and steelhead. Such potential effects are unlikely in the larger, faster-flowing migration corridors but cannot be dismissed in spawning and rearing areas. To adequately assess such indirect risk, more information is needed on the types and abundance of cover present, proximity of use sites to spawning and rearing areas, sizes and flow rates of streams, timing of applications with occurrences of salmonids, and other such relevant information.

g. Existing protective measures

Nationally, there are no specific protective measures for endangered and threatened species beyond the generic statements on the current metolachlor labels. As stated on all pesticide labels, it is a violation of Federal law to use this product in a manner inconsistent with its labeling. The Environmental Hazards section for section 3 labels for metolachlor products requires that applicators adhere to the following:

> "Do not apply directly to water, or to areas where surface water is present or to intertidal areas below the mean high water mark. Do not contaminate water when disposing of equipment washwaters. Do not apply when weather conditions favor drift from the treated area. Apply this product only as specified on this label. Do not allow sprays to drift on to adjacent desirable plants. Observe all cautions and limitations on labeling of all products used in mixtures."

The following surface-water and ground-water advisories also must appear on product labels:

> Surface water: "Metolachlor can contaminate surface water through ground spray drift. Under some conditions, metolachlor may also have a high potential for runoff into surface water (primarily via dissolution in runoff water), for several months post-application. These include poorly draining or wet soils with readily visible slopes toward adjacent surface waters, frequently flooded areas, areas over-laying extremely shallow ground water, areas with in-field canals or ditches that drain to surface water, areas not separated from adjacent surface waters with vegetated filter strips, and areas over-laying tile drainage systems that drain to surface water."

> Ground water: "This chemical is known to leach through soil into ground water under certain conditions as a result of agricultural use. Use of this chemical in

> areas where soils are permeable, particularly where the water table is shallow, may result in ground-water contamination."

Spray drift language also is required on each product label for those products that can be applied aerially:

> "Avoiding spray drift at the application site is the responsibility of the applicator. The interaction of many equipment-and-weather-related factors determine the potential for spray drift. The applicator and the grower are responsible for considering all these factors when making decisions." Additionally, there are drift management requirements that must be followed to avoid off-target drift movement from aerial applications to agricultural field crops (see attached product labels). Product labels also must state that applicators should be familiar with and take into account Aerial Drift Reduction Advisory Information. That advisory provides information on droplet size, controlling droplet size, boom length, application height, swath adjustment, wind speed, temperature and humidity, and temperature inversions. It also states that "The pesticide should only be applied when the potential for drift to adjacent sensitive areas (e.g. residential areas, bodies of water, known habitat for threatened or endangered species, non-target crops) is minimal (e.g. when wind is blowing away from the sensitive areas)."

OPP's endangered species program has developed a series of county bulletins which provide information to pesticide users on steps that would be appropriate for protecting endangered or threatened species. Metolachlor is addressed in bulletins only for protection of threatened and endangered terrestrial plants. Bulletin development is an ongoing process, and there are no bulletins yet developed that would address fish in the Pacific Northwest. OPP is preparing such bulletins.

4. Listed salmon and steelhead ESUs and comparison with metolachlor use areas

The sources of data available on metolachlor use are considerably different for California than for other states. California has full pesticide use reporting by all applicators except homeowners (metolachlor is not registered for homeowner use). Oregon has initiated a process for full use reporting, but it is not in place yet. Washington and Idaho do not have such a mechanism to our knowledge.

The latest information for California pesticide use is for the year 2001 [URL: http://www.cdpr.ca.gov/docs/pur/purmain.htm]. The reported information to the County Agricultural Commissioners includes the crop or noncrop site treated, pounds used, acres treated, and the specific location treated. This information is reported to the state, but the specific location information is retained at the county level and is not available to EPA. The amount of metolachlor used annually in California from 1997 to 2001 is shown in Table 14. Use should continue to decline as existing stocks are depleted.

Table 14. Reported pounds of metolachlor (active ingredient) used in California from 1997 to 2001

1997	1998	1999	2000	2001
212,714	260,231	350,295	145,305	24,800

Information is not available on the amount of metolachlor used in Oregon, Washington, and Idaho counties. For ESUs in these three states, crop acreage by county for those crops on which metolachlor is registered for use is obtained from the 1997 USDA Agricultural Census. However, crop acreage is not necessarily indicative of how much metolachlor is used in that county but is only suggestive of possible use. On the other hand, if no registered crop is grown in a county, then there is no potential use of metolachlor in that county.

In the following discussion of individual ESUs and metolachlor use, we present available information on the listed Pacific salmon and steelhead ESUs and discuss the potential for the use of metolachlor and potential for exposure and risk. Our information on the various ESUs is taken almost entirely from various Federal Register Notices relating to listing, critical habitat, or status reviews. As noted above, usage data were derived from 1997 Agricultural Census and California DPR's pesticide use reporting. As previously noted, metolachlor is not expected to have adverse direct effects on listed Pacific salmon and steelhead but has some potential for indirect effects by reducing aquatic cover. Such an indirect effect could also be construed as an adverse modification of critical habitat. Here, we use best professional judgement to evaluate which ESUs might possibly be impacted through adverse effects on aquatic plants.

A. Steelhead

Steelhead, *Oncorhyncus mykiss*, exhibit one of the most complex suite of life history traits of any salmonid species. Steelhead may exhibit anadromy or freshwater residency. Resident forms are usually referred to as ''rainbow'' or ''redband'' trout, while anadromous life forms are termed ''steelhead.'' The relationship between these two life forms is poorly understood; however, the scientific name was recently changed to represent that both forms are a single species.

Steelhead typically migrate to marine waters after spending 2 years in fresh water. They then reside in marine waters for typically 2 or 3 years prior to returning to their natal stream to spawn as 4- or 5-year-olds. Unlike Pacific salmon, they are capable of spawning more than once before they die. However, it is rare for steelhead to spawn more than twice before dying; most that do so are females. Steelhead adults typically spawn between December and June. Depending on water temperature, steelhead eggs may incubate in redds for 1.5 to 4 months before hatching as alevins. Following yolk sac absorption, alevins emerge as fry and begin actively feeding. Juveniles rear in fresh water from 1 to 4 years, then migrate to the ocean as ''smolts.''

Biologically, steelhead can be divided into two reproductive ecotypes. “Stream maturing” or “summer steelhead” enter fresh water in a sexually immature condition and require several months to mature and spawn. “Ocean maturing,” or “winter steelhead” enter fresh water with well-developed gonads and spawn shortly after river entry. There are also two major genetic groups, applying to both anadromous and nonanadromous forms: a coastal group and an inland group, separated approximately by the Cascade crest in Oregon and Washington. California is thought to have only coastal steelhead while Idaho has only inland steelhead.

Historically, steelhead were distributed throughout the North Pacific Ocean from the Kamchatka Peninsula in Asia to the northern Baja Peninsula, but they are now known only as far south as the Santa Margarita River in San Diego County. Many populations have been extirpated.

1. Southern California Steelhead ESU

The Southern California steelhead ESU was proposed for listing as endangered on August 9, 1996 (61FR41541-41561) and the listing was made final a year later (62FR43937-43954, August 18, 1997). Critical Habitat was proposed February 5, 1999 (64FR5740-5754) and designated on February 16, 2000 (65FR7764-7787). This ESU ranges from the Santa Maria River in San Luis Obispo County south to San Mateo Creek in San Diego County. Steelhead from this ESU may also occur in Santa Barbara, Ventura and Los Angeles counties, but this ESU apparently is no longer considered to be extant in Orange County (65FR79328-79336, December 19, 2000). Hydrologic units in this ESU are Cuyama (upstream barrier - Vaquero Dam), Santa Maria, San Antonio, Santa Ynez (upstream barrier - Bradbury Dam), Santa Barbara Coastal, Ventura (upstream barriers - Casitas Dam, Robles Dam, Matilja Dam, Vern Freeman Diversion Dam), Santa Clara (upstream barrier - Santa Felicia Dam), Calleguas, and Santa Monica Bay (upstream barrier - Rindge Dam). Counties comprising this ESU show a very high percentage of declining and extinct populations. River entry ranges from early November through June, with peaks in January and February. Spawning primarily begins in January and continues through early June, with peak spawning in February and March.

Within San Diego County, the San Mateo Creek runs through Camp Pendleton Marine Base and into the Cleveland National Forest. While there are agricultural uses of pesticides in other parts of California within the range of this ESU, it would appear that there are no such uses in the vicinity of San Mateo Creek. Within Los Angeles County, this steelhead occurs in Malibu Creek and possibly Topanga Creek. Neither of these creeks drain agricultural areas. Since home uses are not registered, there is little likelihood that metolachlor would be used in these watersheds. There is a potential for steelhead waters to drain agricultural areas in Ventura, Santa Barbara, and San Luis Obispo counties.

Usage of metolachlor in counties where this ESU occurs is presented in Table 15. Santa Barbara is the only county in this ESU where metolachlor was applied to more than 50 acres in 2001.

Table 15. Use of metolachlor in 2001 in counties with the Southern California steelhead ESU

County	Crop	Metolachlor usage (lb ai)	Acres treated
San Diego	Kumquat Outdoor flowers	38 33	30 10
Los Angeles	Landscape maintenance	6	nr
Ventura	Beans	79	50
San Luis Obispo		0	0
Santa Barbara	Outdoor flowers Beans Uncultivated non-ag.	1,060 650 3	694 332 1

We conclude that metolachlor may affect, but is not likely to adversely affect, the Southern California steelhead ESU, because of possible adverse effects on aquatic plant cover. However, this finding applies only to Santa Barbara Co.; elsewhere, usage is sufficiently low that adverse effects on aquatic plants are unlikely. With the phase-out of metolachlor in California, use likely decreased in 2002 and will continue to decrease as existing stocks are depleted. Therefore, mitigation may not be necessary for this ESU.

2. South Central California Steelhead ESU

The South Central California steelhead ESU was proposed for listing as endangered on August 9, 1996 (61FR41541-41561) and the listing was made final, as threatened, a year later (62FR43937-43954, August 18, 1997). Critical Habitat was proposed February 5, 1999 (64FR5740-5754) and designated on February 16, 2000 (65FR7764-7787). This coastal steelhead ESU occupies rivers from the Pajaro River, Santa Cruz County, to (but not including) the Santa Maria River, San Luis Obispo County. Most rivers in this ESU drain the Santa Lucia Mountain Range, the southernmost unit of the California Coast Ranges (62FR43937-43954, August 18, 1997). River entry ranges from late November through March, with spawning occurring from January through April.

This ESU includes the hydrologic units of Pajaro (upstream barriers - Chesbro Reservoir, North Fork Pachero Reservoir), Estrella, Salinas (upstream barriers - Nacimiento Reservoir, Salinas Dam, San Antonio Reservoir), Central Coastal (upstream barriers - Lopez Dam, Whale Rock Reservoir), Alisal-Elkhorn Sloughs, and Carmel. Counties of occurrence include Santa Cruz, San Benito, Monterey, and San Luis Obispo. There are agricultural areas in these counties, and these areas would be drained by waters where steelhead critical habitat occurs.

Table 16 shows metolachlor usage in those counties where this ESU occurs. Monterey Co. is the only county where metolachlor was used in any relevant amount in 2001.

Table 16. Use of metolachlor in 2001 in counties with the South Central California steelhead ESU

County	Crop(s)	Metolachlor usage (lb ai)	Acres treated
Santa Cruz		0	0
San Benito	Beans	5	4
Monterey	Beans Peas	1,383 154	650 116
San Luis Obispo		0	0

We conclude that metolachlor may affect, but is not likely to adversely affect, the South Central California steelhead ESU, because of possible adverse effects on aquatic plant cover. However, this finding applies only to Monterey Co.; elsewhere, only four acres were treated in this ESU in 2001. With the phase-out of metolachlor in California, use likely decreased in 2002 and will continue to decrease as existing stocks are depleted. Therefore, mitigation may not be necessary for this ESU.

3. Central California Coast Steelhead ESU

The Central California coast steelhead ESU was proposed for listing as endangered on August 9, 1996 (61FR41541-41561) and the listing was made final, as threatened, a year later (62FR43937-43954, August 18, 1997). Critical Habitat was proposed February 5, 1999 (64FR5740-5754) and designated on February 16, 2000 (65FR7764-7787). This coastal steelhead ESU occupies California river basins from the Russian River, Sonoma County, to Aptos Creek, Santa Cruz County, (inclusive), and the drainages of San Francisco and San Pablo Bays eastward to the Napa River (inclusive), Napa County. The Sacramento-San Joaquin River Basin of the Central Valley of California is excluded. Steelhead in most tributary streams in San Francisco and San Pablo Bays appear to have been extirpated, whereas most coastal streams sampled in the central California coast region do contain steelhead.

Only winter steelhead are found in this ESU and those to the south. River entry ranges from October in the larger basins, late November in the smaller coastal basins, and continues through June. Steelhead spawning begins in November in the larger basins, December in the smaller coastal basins, and can continue through April with peak spawning generally in February and March. Hydrologic units in this ESU include Russian (upstream barriers - Coyote Dam, Warm Springs Dam), Bodega Bay, Suisun Bay, San Pablo Bay (upstream barriers - Phoenix Dam, San Pablo Dam), Coyote (upstream barriers - Almaden, Anderson, Calero, Guadelupe, Stevens Creek, and Vasona Reservoirs, Searsville Lake), San Francisco Bay (upstream barriers - Calveras Reservoir, Chabot Dam, Crystal Springs Reservoir, Del Valle Reservoir, San Antonio Reservoir), San Francisco Coastal South (upstream barrier - Pilarcitos Dam), and San Lorenzo-Soquel (upstream barrier - Newell Dam).

Usage of metolachlor in counties in the Central California coast steelhead ESU is presented in Table 17. Santa Clara is the only county with any significant crop use other than soil fumigation, but only about 116 acres total were treated in 2001.

Table 17. Use of metolachlor in 2001 in counties with the Central California Coast steelhead ESU

County	Crop(s)	Metolachlor usage (lb ai)	Acres treated
Santa Cruz		0	0
San Mateo	Beans Peas	2 5	1 2
San Francisco		0	0
Marin		0	0
Sonoma		0	0
Mendocino		0	0
Napa		0	0
Alameda		0	0
Contra Costa	Soil fumigation/preplant (crops not specified)	52	52
Solano		0	0
Santa Clara	Corn Beans Tomato Pepper	98 48 40 32	77 24 20 16

We conclude that metolachlor may affect, but is not likely to adversely affect, the Central California Coast steelhead ESU, because of possible adverse effects on aquatic plant cover. However, this finding applies only to Santa Clara Co.; elsewhere, only 55 acres were treated in this ESU in 2001. With the phase-out of metolachlor in California, use likely decreased in 2002 and will continue to decrease as existing stocks are depleted. Therefore, mitigation may not be necessary for this ESU.

4. California Central Valley Steelhead ESU

The California Central Valley steelhead ESU was proposed for listing as endangered on August 9, 1996 (61FR41541-41561) and the listing was made final in 1998 (63FR 13347-13371, March 18, 1998). Critical Habitat was proposed February 5, 1999 (64FR5740-5754) and designated on February 16, 2000 (65FR7764-7787).

This ESU includes populations ranging from Shasta, Trinity, and Whiskeytown areas, along with other Sacramento River tributaries in the North, down the Central Valley along the San Joaquin River to and including the Merced River in the South, and then into San Pablo and San Francisco Bays. Counties at least partly within this area are Alameda, Amador, Butte, Calaveras, Colusa, Contra Costa, Glenn, Marin, Merced, Nevada, Placer, Sacramento, San Francisco, San Joaquin, San Mateo, Solano, Sonoma, Stanislaus, Sutter, Tehama, Tuloumne, Yolo, and Yuba. A large proportion of this area is heavily agricultural. Usage of metolachlor in this ESU is provided in Table 18.

Table 18. Use of metolachlor in counties with the California Central Valley steelhead ESU

County	Crop(s)	Metolachlor usage (lb ai)	Acres treated
Alameda		0	0
Amador		0	0
Butte	Beans Corn	398 160	274 50
Calaveras		0	0
Colusa	Cotton Tomato Corn Beans	4,117 1,945 286 171	3,280 2,410 140 90
Contra Costa	Soil fumigation/preplant (crops not specified)	52	52
Glenn	Corn Beans	1,000 73	485 57
Marin		0	0
Merced	Beans Corn Cotton	928 299 326	771 151 231

County	Crop(s)	Metolachlor usage (lb ai)	Acres treated
Nevada		0	0
Placer	Corn	507	401
Sacramento	Beans Landscape maintenance Corn	139 115 95	70 nr 48
San Joaquin	Beans Corn	659 614	411 187
San Mateo	Beans Peas	2 5	1 2
San Francisco		0	0
Shasta		0	0
Solano		0	0
Sonoma		0	0
Stanislaus	Corn Beans Landscape maintenance	4,192 607 15	608 325 nr
Sutter	Tomato Corn Beans	2,805 553 251	4,147 289 241
Tehama	Beans Corn Uncultivated ag.	403 131 19	319 76 10
Tuloumne		0	0
Yolo	Corn	184	116
Yuba	Corn	238	167

We conclude that metolachlor may affect, but is not likely to adversely affect, the California Central Valley steelhead ESU, because of possible adverse effects on aquatic plant cover, especially around Colusa and Sutter counties but in several other counties as well. However, use likely decreased in 2002 with the phase-out of metolachlor in California, and it will continue to decrease as existing stocks are depleted. Therefore, mitigation may not be necessary for this ESU.

5. Northern California Steelhead ESU

The Northern California steelhead ESU was proposed for listing as threatened on February 11, 2000 (65FR6960-6975) and the listing was made final on June 7, 2000 (65FR36074-36094). Critical Habitat has not yet been officially established.

This Northern California coastal steelhead ESU occupies river basins from Redwood Creek in Humboldt County, CA to the Gualala River, inclusive, in Mendocino County, CA. River entry ranges from August through June and spawning from December through April, with peak spawning in January in the larger basins and in late February and March in the smaller coastal basins. The Northern California ESU has both winter and summer steelhead, including what is presently considered to be the southernmost population of summer steelhead, in the Middle Fork Eel River. Counties included appear to be Humboldt, Mendocino, Trinity, and Lake.

Metolachlor is applied only to flowers and only in Humboldt Co. in this ESU (Table 19).

Table 19. Use of metolachlor in counties with the Northern California steelhead ESU

County	Crop(s)	Metolachlor usage (lb ai)	Acres treated
Humboldt	Outdoor flowers Greenhouse flowers	157 24	80 63
Mendocino		0	0
Trinity		0	0
Lake		0	0

We conclude that metolachlor will have no affect on the Northern California steelhead ESU, because so little metolachlor was used outdoors in 2001. Use should continue to decline in this ESU with the phase-out of metolachlor in California.

6. Upper Columbia River steelhead ESU

The Upper Columbia River steelhead ESU was proposed for listing as endangered on August 9, 1996 (61FR41541-41561) and the listing was made final a year later (62FR43937-43954, August 18, 1997). Critical Habitat was proposed February 5, 1999 (64FR5740-5754) and designated on February 16, 2000 (65FR7764-7787).

The Upper Columbia River steelhead ESU ranges from several northern rivers close to the Canadian border in central Washington (Okanogan and Chelan counties) to the mouth of the Columbia River. The primary area for spawning and growth through the smolt stage of this ESU is from the Yakima River in south Central Washington upstream. Hydrologic units within the spawning and rearing habitat of the Upper Columbia River steelhead ESU and their upstream barriers are Chief Joseph (upstream barrier - Chief Joseph Dam), Okanogan, Similkameen, Methow, Upper Columbia-Entiat, Wenatchee, Moses-Coulee, and Upper Columbia-Priest Rapids. Within the spawning and rearing areas, counties are Chelan, Douglas, Okanogan, Grant, Benton, Franklin, Kittitas, and Yakima, all in Washington.

Areas downstream from the Yakima River are used for migration. Additional counties through which the ESU migrates are Walla Walla, Klickitat, Skamania, Clark, Columbia, Cowlitz, Wahkiakum, and Pacific, Washington; and Gilliam, Morrow, Sherman, Umatilla, Wasco, Hood River, Multnomah, Columbia, and Clatsop, Oregon.

Crops on which metolachlor is potentially used in Washington and Oregon counties in this ESU are shown in Tables 20 and 21. Within the spawning and growth areas of this ESU, a large acreage of potatoes and corn is grown in Franklin, Benton, Yakima, and Grant counties, and peas and beans in Grant Co. The counties growing most of these crops in the migration corridor for this ESU are Umatilla, Walla Walla, and Morrow.

Table 20. Crops on which metolachlor can be used in Washington counties where there is spawning and growth of the Upper Columbia River steelhead ESU

State	County	Crops	Acres planted
WA	Benton	Potatoes	25,317
WA	Franklin	Potatoes Corn Beans Peas Lima beans	35,770 12,594 2,706 1,096 998
WA	Kittitas	Potatoes Corn	442 110
WA	Yakima	Corn Beans Potatoes Peas Lima beans	24,053 2,251 1,929 1,745 731
WA	Chelan		0
WA	Douglas		0

State	County	Crops	Acres planted
WA	Okanogan		0
WA	Grant	Corn Peas Beans Lima bean	35,123 19,602 18,024 3,878

Table 21. Crops on which metolachlor can be used in Oregon and Washington counties that are migration corridors for the Upper Columbia River steelhead ESU

State	County	Crops	Acres planted
WA	Walla Walla	Peas Corn Beans Lima beans	16,658 7,066 5,707 458
WA	Klickitat		0
WA	Skamania		0
WA	Clark	Corn	1,817
WA	Cowlitz	Peas Corn	771 460
WA	Wahkiakum		0
WA	Pacific		0
OR	Gilliam		0
OR	Umatilla	Peas Corn Beans Lima beans	31,187 7,903 2,088 1,239
OR	Sherman		0
OR	Morrow	Potatoes Corn Peas	17,030 9,276 729
OR	Wasco		0
OR	Hood River		0

State	County	Crops	Acres planted
OR	Multnomah	Corn Peas Beans	1,405 616 77
OR	Columbia	Corn	48
OR	Clatsop	Corn	5

We conclude that metolachlor may affect the Upper Columbia River steelhead ESU in spawning and rearing habitat. Although there are no data available on how many acres are actually treated or how many pounds of metolachlor are applied in this ESU, the extent of crop acreage and the possibility of exposure in some of the smaller tributaries leads us to believe that metolachlor might affect this ESU through reduction in aquatic cover. Because the migration corridors consist of larger, faster-flowing streams, impacts on aquatic-plant cover seem unlikely where steelhead migrate. For those counties associated with spawning and rearing habitat, we recommend requiring a buffer to minimize runoff and drift into surface waters. Alternatively, allowing only preplant incorporated application for corn and pod crops would reduce runoff and potential exposure of aquatic plants in most counties, but not in Benton or Franklin counties if metolachlor is used there on potatoes. The Washington State Department of Agriculture's task force also may provide more focused protective measures that would be acceptable.

7. Snake River Basin steelhead ESU

The Snake River Basin steelhead ESU was proposed for listing as endangered on August 9, 1996 (61FR41541-41561) and the listing was made final a year later (62FR43937-43954, August 18, 1997). Critical Habitat was proposed February 5, 1999 (64FR5740-5754) and designated on February 16, 2000 (65FR7764-7787).

Spawning and early growth areas of this ESU consist of all areas upstream from the confluence of the Snake River and the Columbia River as far as fish passage is possible. Hells Canyon Dam on the Snake River and Dworshak Dam on the Clearwater River, along with Napias Creek Falls near Salmon, Idaho, are named as impassable barriers. These areas include the counties of Wallowa, Baker, Union, and Umatilla (northeastern part) in Oregon; Asotin, Garfield, Columbia, Whitman, Franklin, and Walla Walla in Washington; and Adams, Idaho, Nez Perce, Blaine, Custer, Lemhi, Boise, Valley, Lewis, Clearwater, and Latah in Idaho. I have excluded Baker County, Oregon, which has a tiny fragment of the Imnaha River watershed. While a small part of Rock Creek that extends into Baker County, this occurs at 7200 feet in the mountains (partly in a wilderness area) and is of no significance with respect to metolachlor use in agricultural areas. I have similarly excluded the Upper Grande Ronde watershed tributaries (e.g., Looking Glass and Cabin Creeks) that are barely into higher elevation forested areas of Umatilla County. However, crop areas of Umatilla County are considered in the migratory routes. In Idaho, Blaine and Boise counties technically have waters that are part of the steelhead

ESU, but again, these are tiny areas which occur in the Sawtooth National Recreation Area and/or National Forest lands. I have excluded these areas because they are not relevant to use of metolachlor. The agricultural areas of Valley County, Idaho, appear to be primarily associated with the Payette River watershed, but there is enough of the Salmon River watershed in this county that I was not able to exclude it.

Critical Habitat also includes the migratory corridors of the Columbia River from the confluence of the Snake River to the Pacific Ocean. Additional counties in the migratory corridors are Umatilla, Gilliam, Morrow, Sherman, Wasco, Hood River, Multnomah, Columbia, and Clatsop in Oregon; and Benton, Klickitat, Skamania, Clark, Cowlitz, Wahkiakum, and Pacific in Washington.

Tables 22 and 23 show the cropping information for the Pacific Northwest counties encompassing spawning and rearing habitat of the Snake River Basin steelhead ESU and for the Oregon and Washington counties where this ESU migrates. Peas and beans are major crops in counties such as Whitman, Walla Walla, Nez Perce, Latah, Lewis, and others, and potatoes are widely grown in Franklin and Adams counties. Peas and potatoes also are grown in the migration corridor, especially in Umatilla, Benton, Walla Walla, and Morrow counties.

Table 22. Crops on which metolachlor can be used in Pacific Northwest counties which provide spawning and rearing habitat for the Snake River Basin steelhead ESU

State	County	Crops	Acres planted
ID	Adams	Corn	104
ID	Idaho	Peas Corn	1,517 117
ID	Nez Perce	Peas Beans	27,475 4,561
ID	Custer	Potatoes	507
ID	Lemhi		0
ID	Valley	Potatoes	225
ID	Lewis	Peas	8,434
ID	Clearwater	Peas Beans	1,369 218
ID	Latah	Peas Beans	25,651 1,135

State	County	Crops	Acres planted
WA	Adams	Potatoes Beans, dry edible Corn Peas Snap beans	27,914 8,148 6,878 2,032 102
WA	Asotin		0
WA	Garfield		0
WA	Columbia	Peas Corn	6,401 51
WA	Whitman	Peas Beans Corn	89,945 1,283 101
WA	Franklin	Potatoes Corn Beans Peas Lima beans	35,770 12,594 2,706 1,096 998
WA	Walla Walla	Peas Corn Beans Lima beans	16,658 7,066 5,707 458
OR	Wallowa		0
OR	Union	Potatoes Beans Peas	660 661 390

Table 23. Crops on which metolachlor can be used in Washington and Oregon counties through which the Snake River Basin steelhead ESU migrates

State	County	Crops	Acres planted
WA	Walla Walla	Peas Corn Beans Lima beans	16,658 7,066 5,707 458

State	County	Crops	Acres planted
WA	Benton	Potatoes Corn	25,317 357
WA	Klickitat		0
WA	Skamania		0
WA	Clark	Corn	1,730
WA	Cowlitz	Peas Corn	771 460
WA	Wahkiakum		0
WA	Pacific		0
OR	Umatilla	Peas Corn Beans Lima beans	31,187 7,903 2,088 1,239
OR	Morrow	Potatoes Corn Peas	17,030 9,276 729
OR	Gilliam		0
OR	Sherman		0
OR	Wasco		0
OR	Hood River		0
OR	Multnomah	Corn Peas Beans	1,405 616 77
OR	Columbia	Corn	48
OR	Clatsop	Corn	5

We conclude that metolachlor may affect the Snake River Basin steelhead ESU in spawning and rearing habitat, because of the extent of crop acreage on which metolachlor might be applied and its possible adverse effects on aquatic plant cover. However, no data are available on how many acres are actually treated annually or how many pounds of metolachlor are actually applied in these counties. We recommend requiring a buffer to minimize runoff and drift into surface waters. Alternatively, allowing only preplant incorporated application for corn and pod crops would reduce runoff and potential exposure of aquatic plants in most counties, but not in Franklin or Adams counties if metolachlor is used there on potatoes. The Washington State Department of Agriculture's task force also may provide more focused protective measures that would be acceptable.

8 Upper Willamette River steelhead ESU

The Upper Willamette River steelhead ESU was proposed for listing as threatened on March 10, 1998 (63FR11798-11809) and the listing was made final a year later (64FR14517-14528, March 25, 1999). Critical Habitat was proposed February 5, 1999 (64FR5740-5754) and designated on February 16, 2000 (65FR7764-7787). Only naturally spawned, winter steelhead trout are included as part of this ESU; where distinguishable, summer-run steelhead trout are not included.

Spawning and rearing areas are river reaches accessible to listed steelhead in the Willamette River and its tributaries above Willamette Falls up through the Calapooia River. This includes most of Benton, Linn, Polk, Clackamas, Marion, Yamhill, and Washington counties, and small parts of Lincoln and Tillamook counties. However, the latter two counties are small portions in forested areas where metolachlor would not be used, and these counties are excluded from my analysis. While the Willamette River extends upstream into Lane County, the final Critical Habitat Notice does not include the Willamette River (mainstem, Coastal and Middle forks) in Lane County or the MacKenzie River and other tributaries in this county that were in the proposed Critical Habitat.

Hydrologic units where spawning and rearing occur are Upper Willamette, North Santiam (upstream barrier - Big Cliff Dam), South Santiam (upstream barrier - Green Peter Dam), Middle Willamette, Yamhill, Molalla-Pudding, and Tualatin.

The areas below Willamette Falls and downstream in the Columbia River are considered migration corridors, and include Multnomah, Columbia and Clatsop counties, Oregon, and Clark, Cowlitz, Wahkiakum, and Pacific counties, Washington.

Tables 24 and 25 show the cropping information for Oregon counties where the Upper Willamette River steelhead ESU is located and for the Oregon and Washington counties where this ESU migrates. Beans and corn are the major crops potentially treated by metolachlor in the spawning and rearing habitat.

Table 24. Crops on which metolachlor can be used that are part of the spawning and rearing habitat of the Upper Willamette River steelhead ESU

State	County	Crops	Acres planted
OR	Benton	Corn Beans	525 3,080
OR	Linn	Corn Beans	1,976 2,688
OR	Polk	Corn Beans	1,472 598
OR	Clackamas	Corn Beans Peas	735 337 104
OR	Marion	Beans Corn Peas Lima beans	12,101 2,158 686 115
OR	Yamhill	Beans Corn	1,838 2,173
OR	Washington	Corn Beans Peas	3,193 988 840

Table 25. Crops on which metolachlor can be used in Oregon and Washington counties that are part of the migration corridors of the Upper Willamette River steelhead ESU

State	County	Crops	Acres planted
WA	Clark	Corn	1,730
WA	Cowlitz	Peas Corn	771 460
WA	Wahkiakum		0
WA	Pacific	Alfalfa	0
OR	Multnomah	Corn Peas Beans	1,405 616 77
OR	Columbia	Corn	48
OR	Clatsop	Corn	5

We conclude that metolachlor may affect the Upper Willamette River steelhead ESU in spawning and rearing habitat, because of the extent of crop acreage on which metolachlor might be applied and its possible adverse effects on aquatic plant cover. However, no data are available on how many acres are actually treated or how many pounds of metolachlor are applied in this ESU, especially for corn. Because the migration corridors consist of larger, faster-flowing streams, impacts on aquatic-plant cover seem unlikely where steelhead migrate. For those counties associated with spawning and rearing habitat, we recommend requiring a buffer to minimize runoff and drift into surface waters. Alternatively, allowing only preplant incorporated application for corn and pod crops would reduce runoff and potential exposure of aquatic plants in this ESU. The Washington State Department of Agriculture's task force also may provide more focused protective measures that would be acceptable.

9. Lower Columbia River steelhead ESU

The Lower Columbia River steelhead ESU was proposed for listing as endangered on August 9, 1996 (61FR41541-41561) and the listing was made final a year later (62FR43937-43954, August 18, 1997). Critical Habitat was proposed February 5, 1999 (64FR5740-5754) and designated on February 16, 2000 (65FR7764-7787).

This ESU includes all tributaries from the lower Willamette River (below Willamette Falls) to Hood River in Oregon, and from the Cowlitz River up to the Wind River in Washington. These tributaries would provide the spawning and presumably the growth areas for the young steelhead. It is not clear if the young and growing steelhead in the tributaries would use the nearby mainstem of the Columbia prior to downstream migration. If not, the spawning and rearing habitat would occur in the counties of Hood River, Clackamas, and Multnomah counties in Oregon, and Skamania, Clark, and Cowlitz counties in Washington. Tributaries of the extreme lower Columbia River, e.g., Grays River in Pacific and Wahkiakum counties, Washington and John Day River in Clatsop county, Oregon, are not discussed in the Critical Habitat FRNs; because they are not "between" the specified tributaries, they do not appear part of the spawning and rearing habitat for this steelhead ESU. The mainstem of the Columbia River from the mouth to Hood River constitutes the migration corridor. This would additionally include Columbia and Clatsop counties, Oregon, and Pacific and Wahkiakum counties, Washington.

Hydrologic units for this ESU are Middle Columbia-Hood, Lower Columbia-Sandy (upstream barrier - Bull Run Dam 2), Lewis (upstream barrier - Merlin Dam), Lower Columbia-Clatskanie, Lower Cowlitz, Lower Columbia, Clackamas, and Lower Willamette.

Tables 26 and 27 show the cropping information for Oregon and Washington counties where the Lower Columbia River steelhead ESU is located and for the Oregon and Washington counties where this ESU migrates. Some corn and peas are grown in counties with spawning and rearing habitat for this ESU, but only a few acres of corn occurs in counties of the migration corridor.

Table 26. Crops and acreage where metolachlor can be used in counties that provide spawning and rearing habitat for the Lower Columbia River Steelhead ESU

State	County	Crops	Acres planted
OR	Hood River		0
OR	Clackamas	Corn Beans Peas	735 337 104
OR	Multnomah	Corn Peas Beans	1,405 616 77
WA	Clark	Corn	1,730
WA	Cowlitz	Peas Corn	771 460
WA	Skamania		0

Table 27. Crops and acreage where metolachlor can be used in counties that are migratory corridors for the Lower Columbia River Steelhead ESU

State	County	Crops	Acres planted
OR	Columbia	Corn	48
OR	Clatsop	Corn	5
WA	Pacific		0
WA	Wahkiakum		0

We conclude that metolachlor may affect the Lower Columbia River steelhead ESU in spawning and rearing habitat, because of the extent of crop acreage on which metolachlor might be applied and its possible adverse effects on aquatic plant cover. However, no data are available on how many acres are actually treated or how many pounds of metolachlor are applied in this ESU, especially for corn. We also conclude that impacts on aquatic-plant cover seem unlikely where steelhead migrate, because the Columbia River is large and few, if any, acres of corn are potentially treated with metolachlor. Alternatively, allowing only preplant incorporated application for corn and pod crops would reduce runoff and potential exposure of aquatic plants. The Washington State Department of Agriculture's task force also may provide more focused protective measures that would be acceptable.

10. Middle Columbia River Steelhead ESU

The Middle Columbia River steelhead ESU was proposed for listing as threatened on March 10, 1998 (63FR11798-11809) and the listing was made final a year later (64FR14517-14528, March 25, 1999). Critical Habitat was proposed February 5, 1999 (64FR5740-5754) and designated on February 16, 2000 (65FR7764-7787).

This steelhead ESU occupies "the Columbia River Basin and tributaries from above the Wind River in Washington and the Hood River in Oregon (exclusive), upstream to, and including, the Yakima River, in Washington." The Critical Habitat designation indicates the downstream boundary of the ESU to be Mosier Creek in Wasco County, Oregon; this is consistent with Hood River being "excluded" in the listing notice. No downstream boundary is listed for the Washington side of the Columbia River, but if Wind River is part of the Lower Columbia steelhead ESU, it appears that Collins Creek, Skamania County, Washington would be the last stream down river in the Middle Columbia River ESU. Dog Creek may also be part of the ESU, but White Salmon River certainly is, since the Condit Dam is mentioned as an upstream barrier. Although I am unsure of the status of these Dog and Collins creeks, they have little relevance to the analysis of metolachlor because there are only 716 acres of potential use sites in Skamania for metolachlor, and it would be expected that these acres would be in the agricultural rather than forest areas of the county.

The only other upstream barrier, in addition to Condit Dam on the White Salmon River is the Pelton Dam on the Deschutes River. As an upstream barrier, this dam would preclude steelhead from reaching the Metolius and Crooked Rivers as well the upper Deschutes River and its tributaries.

In the John Day River watershed, we have excluded Harney County, Oregon because there is only a tiny amount of the John Day River and several tributary creeks (e.g., Utley, Bear Cougar creeks) which get into high elevation areas (approximately 1700M and higher) of northern Harney County where there are no crops grown. Similarly, the Umatilla River and Walla Walla River get barely into Union County OR, and the Walla Walla River even gets into a tiny piece of Wallowa County, Oregon. But again, these are high elevation areas where crops are not grown, and I have excluded these counties for this analysis.

The Oregon counties then that appear to have spawning and rearing habitat are Gilliam, Morrow, Umatilla, Sherman, Wasco, Crook, Grant, Wheeler, and Jefferson counties. Hood River, Multnomah, Columbia, and Clatsop counties in Oregon provide migratory habitat. Washington counties providing spawning and rearing habitat would be Benton, Columbia, Franklin, Kittitas, Klickitat, Skamania, Walla Walla, and Yakima, although only a small portion of Franklin County between the Snake River and the Yakima River is included in this ESU. Skamania, Clark, Cowlitz, Wahkiakum, and Pacific Counties in Washington provide migratory corridors.

Tables 28 and 29 show the cropping information for Oregon and Washington counties where the Middle Columbia River steelhead ESU is located and for the Oregon and Washington counties where this ESU migrates. A considerable acreage of potatoes, peas, and corn is grown in several counties that encompass spawning and rearing habitat.

Table 28. Crops and acreage where metolachlor can be used in counties that provide spawning and rearing habitat for the Middle Columbia River Steelhead ESU

State	County	Crops	Acres planted
OR	Gilliam		0
OR	Morrow	Potatoes Corn Peas	17,030 9,276 729
OR	Umatilla	Peas Corn Beans Lima beans	31,187 7,903 2,088 1,239
OR	Sherman		0

State	County	Crops	Acres planted
OR	Wasco		0
OR	Crook		0
OR	Grant		0
OR	Wheeler		0
OR	Jefferson	Beans	220
WA	Benton	Potatoes Corn	25,317 357
WA	Columbia	Peas Corn	6,401 51
WA	Franklin	Potatoes Corn Beans Peas Lima beans	35,770 12,594 2,706 1,096 998
WA	Kittitas	Potatoes Corn	442 110
WA	Klickitat		0
WA	Skamania		0
WA	Walla Walla	Peas Corn Beans Lima beans	16,658 7,066 5,707 458
WA	Yakima	Corn Beans Potatoes Peas Lima beans	24,053 2,251 1,929 1,745 731

Table 29. Crops on which metolachlor can be used in Washington and Oregon counties through which the Middle Columbia River steelhead ESU migrates

State	County	Crops	Acres planted
WA	Skamania		0
WA	Clark	Corn	1,817
WA	Cowlitz	Peas Corn	771 460
WA	Pacific		0
WA	Wahkiakum		0
OR	Hood River		0
OR	Multnomah	Corn Peas Beans	1,405 616 77
OR	Columbia	Corn	48
OR	Clatsop	Corn	5

We conclude that metolachlor may affect the Middle Columbia River steelhead ESU in spawning and rearing habitat, because of the extent of crop acreage on which metolachlor might be applied and its possible adverse effects on aquatic plant cover. However, no data are available on how many acres are actually treated or how many pounds of metolachlor are applied in this ESU. Because the migration corridors consist of larger, faster-flowing streams, impacts on aquatic-plant cover seem unlikely where steelhead migrate. We recommend requiring a buffer to minimize runoff and drift into surface waters. Alternatively, allowing only preplant incorporated application for corn and pod crops would reduce runoff and potential exposure of aquatic plants in most counties, but not in those counties, if any, where metolachlor is used on potatoes. The Washington State Department of Agriculture's task force also may provide more focused protective measures that would be acceptable.

B. Chinook salmon

Chinook salmon *(Oncorhynchus tshawytscha)* is the largest salmon species; adults weighing over 120 pounds have been caught in North American waters. Like other Pacific salmon, chinook salmon are anadromous and die after spawning.

Juvenile stream- and ocean-type chinook salmon have adapted to different ecological niches. Ocean-type chinook salmon, commonly found in coastal streams, tend to utilize estuaries and coastal areas more extensively for juvenile rearing. They typically migrate to sea within the first three months of emergence and spend their ocean life in coastal waters. Summer and fall runs predominate for ocean-type chinook. Stream-type chinook are found most commonly in headwater streams and are much more dependent on freshwater stream ecosystems because of their extended residence in these areas. They often have extensive offshore migrations before returning to their natal streams in the spring or summer months. Stream-type smolts are much larger than their younger ocean-type counterparts and are therefore able to move offshore relatively quickly.

Coastwide, chinook salmon typically remain at sea for 2 to 4 years, with the exception of a small proportion of yearling males (called jack salmon) which mature in freshwater or return after 2 or 3 months in salt water. Ocean-type chinook salmon tend to migrate along the coast, while stream-type chinook salmon are found far from the coast in the central North Pacific. They return to their natal streams with a high degree of fidelity. Seasonal ‘‘runs’’ (i.e., spring, summer, fall, or winter), which may be related to local temperature and water flow regimes, have been identified on the basis of when adult chinook salmon enter freshwater to begin their spawning migration. Egg deposition must occur at a time to ensure that fry emerge during the following spring when the river or estuary productivity is sufficient for juvenile survival and growth.

Adult female chinook will prepare a spawning bed, called a redd, in a stream area with suitable gravel composition, water depth and velocity. After laying eggs in a redd, adult chinook will guard the redd from 4 to 25 days before dying. Chinook salmon eggs will hatch, depending upon water temperatures, between 90 to 150 days after deposition. Juvenile chinook may spend from 3 months to 2 years in freshwater after emergence and before migrating to estuarine areas as smolts, and then into the ocean to feed and mature. Historically, chinook salmon ranged as far south as the Ventura River, California, and their northern extent reaches the Russian Far East.

1. Sacramento River Winter-run Chinook Salmon ESU

The Sacramento River Winter-run chinook was emergency listed as threatened with critical habitat designated in 1989 (54FR32085-32088, August 4, 1989). This emergency listing provided interim protection and was followed by (1) a proposed rule to list the winter-run on March 20, 1990, (2) a second emergency rule on April 20, 1990, and (3) a formal listing on November 20, 1990 (59FR440-441, January 4, 1994). A somewhat expanded critical habitat was proposed in 1992 (57FR36626-36632, August 14, 1992) and made final in 1993 (58FR33212-33219, June 16, 1993). In 1994, the winter-run was reclassified as endangered because of significant declines and continued threats (59FR440-441, January 4, 1994).

Critical Habitat has been designated to include the Sacramento River from Keswick Dam, Shasta County (river mile 302) to Chipps Island (river mile 0) at the west end of the Sacramento-San Joaquin delta, and then westward through most of the fresh or estuarine waters, north of the

Oakland Bay Bridge, to the ocean. Estuarine sloughs in San Pablo and San Francisco bays are excluded (58FR33212-33219, June 16, 1993).

Most use of metolachlor in this ESU was on tomatoes and cotton in 2001, mostly in Colusa and Sutter counties (Table 30). No metolachlor was used in Shasta Co. and few acres were treated in Tehama Co.

Table 30. Use of metolachlor in counties with the Sacramento River winter-run chinook salmon ESU. Spawning areas are primarily in Shasta and Tehama counties above the Red Bluff diversion dam

County	Crop(s)	Metolachlor usage (lb ai)	Acres treated
Alameda		0	0
Butte	Beans Corn	398 160	274 50
Colusa	Cotton Tomato Corn Beans	4,117 1,945 286 171	3,280 2,410 140 90
Contra Costa	Soil fumigation/preplant (crops not specified)	52	52
Glenn	Corn Beans	1,000 73	485 57
Marin		0	0
Sacramento	Beans Landscape maintenance Corn	139 115 95	70 nr 48
San Mateo	Beans Peas	2 5	1 2
San Francisco		0	0
Shasta		0	0
Solano		0	0
Sonoma		0	0

County	Crop(s)	Metolachlor usage (lb ai)	Acres treated
Sutter	Tomato Corn Beans	2,805 553 251	4,147 289 241
Tehama	Beans Corn Uncultivated ag.	403 131 19	319 76 10
Yolo	Corn	184	116

We conclude that metolachlor has no effect on the Sacramento River winter-run chinook salmon, because chinook spawning occurs primarily in Shasta and Tehama counties and little or no metolachlor was used there in 2001. With the phase-out of metolachlor in California, use likely decreased in 2002 and will continue to decrease as existing stocks are depleted.

2. Snake River Fall-run Chinook Salmon ESU

The Snake River fall-run chinook salmon ESU was proposed as threatened in 1991 (56FR29547-29552, June 27, 1991) and listed about a year later (57FR14653-14663, April 22, 1992). Critical habitat was designated on December 28, 1993 (58FR68543-68554) to include all tributaries of the Snake and Salmon Rivers accessible to Snake River fall-run chinook salmon, except reaches above impassable natural falls and Dworshak and Hells Canyon Dams. The Clearwater River and Palouse River watersheds are included for the fall-run ESU, but not for the spring/summer run. This chinook ESU was proposed for reclassification on December 28, 1994 (59FR66784-57403) as endangered because of critically low levels, based on very sparse runs. However, because of increased runs in subsequent year, this proposed reclassification was withdrawn (63FR1807-1811, January 12, 1998).

In 1998, NMFS proposed to revise the Snake River fall-run chinook to include those stocks using the Deschutes River (63FR11482-11520, March 9, 1998). The John Day, Umatilla, and Walla Walla Rivers would be included; however, fall-run chinook in these rivers are believed to have been extirpated. It appears that this proposal has yet to be finalized. We have not included these counties here; however, we would note that the Middle Columbia River steelhead ESU encompasses these basins, and crop information is presented in that section of this analysis.

Hydrologic units with spawning and rearing habitat for this fall-run chinook are the Clearwater, Hells Canyon, Imnaha, Lower Grande Ronde, Lower North Fork Clearwater, Lower Salmon, Lower Snake-Asotin, Lower Snake-Tucannon, and Palouse. These units are in Baker, Umatilla, Wallowa, and Union counties in Oregon; Adams, Asotin, Columbia, Franklin, Garfield, Lincoln, Spokane, Walla Walla, and Whitman counties in Washington; and Adams, Benewah, Clearwater, Idaho, Latah, Lewis, Nez Perce, Shoshone, and Valley counties in Idaho. I note that Custer and Lemhi counties in Idaho are not listed as part of the fall-run ESU, although they are included for the spring/summer-run ESU. Because only high elevation forested areas of Baker and Umatilla counties in Oregon are in the spawning and rearing areas for this fall-run chinook, we have excluded them from consideration because metolachlor would not be used in these areas. We have, however, kept Umatilla County as part of the migratory corridor.

Tables 31 and 32 show the cropping information for Pacific Northwest counties where the Snake River fall-run chinook salmon ESU is located and for the Oregon and Washington counties where this ESU migrates. Peas, potatoes, and corn are widely grown in several counties, especially Whitman, Franklin, Nez Perce, Adams, Latah, Walla Walla, and Spokane within the spawning and rearing habitat for the Snake River fall-run chinook ESU.

Table 31. Crops on which metolachlor can be used in Pacific Northwest counties which provide spawning and rearing habitat for the Snake River fall-run chinook ESU

State	County	Crops	Acres planted
ID	Adams	Corn	104
ID	Idaho	Peas Corn	1,517 117
ID	Nez Perce	Peas Beans	27,475 4,561
ID	Valley	Potatoes	225
ID	Lewis	Peas	8,434
ID	Benewah	Peas	370
ID	Shoshone		0
ID	Clearwater	Peas Beans	1,369 218
ID	Latah	Peas Beans	25,651 1,135
WA	Adams	Potatoes Beans, dry edible Corn Peas Snap beans	27,914 8,148 6,878 2,032 102

State	County	Crops	Acres planted
WA	Lincoln	Peas Potatoes Corn	1,148 771 564
WA	Spokane	Peas Corn	19,596 128
WA	Asotin		0
WA	Garfield		0
WA	Columbia	Peas Corn	6,401 51
WA	Whitman	Peas Beans Corn	89,945 1,283 101
WA	Franklin	Potatoes Corn Beans Peas Lima beans	35,770 12,594 2,706 1,096 998
WA	Walla Walla	Peas Corn Beans Lima beans	16,658 7,066 5,707 458
OR	Wallowa		0
OR	Union	Potatoes Beans Peas	660 661 390

Table 32. Crops on which metolachlor can be used in Washington and Oregon counties through which the Snake River fall-run chinook and the Snake River fall-run chinook ESUs migrate

State	County	Crops	Acres planted
WA	Walla Walla	Peas Corn Beans Lima beans	16,658 7,066 5,707 458
WA	Benton	Potatoes Corn	25,317 357
WA	Klickitat		0
WA	Skamania		0
WA	Clark	Corn	1,817
WA	Cowlitz	Peas Corn	771 460
WA	Wahkiakum		0
WA	Pacific		0
OR	Umatilla	Peas Corn Beans Lima beans	31,187 7,903 2,088 1,239
OR	Morrow	Potatoes Corn Peas	17,030 9,276 729
OR	Gilliam		0
OR	Sherman		0
OR	Wasco		0
OR	Hood River		0
OR	Multnomah	Corn Peas Beans	1,405 616 77
OR	Columbia	Corn	48

State	County	Crops	Acres planted
OR	Clatsop	Corn	5

We conclude that metolachlor may affect the Snake River fall-run chinook ESU, because of the extent of crop acreage on which metolachlor might be applied and its possible adverse effects on aquatic plant cover. However, no data are available on how many acres are actually treated or how many pounds of metolachlor are applied in this ESU. Because the migration corridors consist of larger, faster-flowing streams, impacts on aquatic-plant cover seem unlikely where chinook migrate. We recommend requiring a buffer to minimize runoff and drift into surface waters. Alternatively, allowing only preplant incorporated application for corn and pod crops would reduce runoff and potential exposure of aquatic plants in most counties, but not in Franklin or Adams counties if metolachlor is used there on potatoes. The Washington State Department of Agriculture's task force also may provide more focused protective measures that would be acceptable.

3. Snake River Spring/Summer-run Chinook Salmon

The Snake River Spring/Summer-run chinook salmon ESU was proposed as threatened in 1991 (56FR29542-29547, June 27, 1991) and listed about a year later (57FR14653-14663, April 22, 1992). Critical habitat was designated on December 28, 1993 (58FR68543-68554) to include all tributaries of the Snake and Salmon Rivers (except the Clearwater River) accessible to Snake River spring/summer chinook salmon. Like the fall-run chinook, the spring/summer-run chinook ESU was proposed for reclassification on December 28, 1994 (59FR66784-57403) as endangered because of critically low levels, based on very sparse runs. However, because of increased runs in subsequent year, this proposed reclassification was withdrawn (63FR1807-1811, January 12, 1998).

Hydrologic units in the potential spawning and rearing areas include Hells Canyon, Imnaha, Lemhi, Little Salmon, Lower Grande Ronde, Lower Middle Fork Salmon, Lower Salmon, Lower Snake-Asotin, Lower Snake-Tucannon, Middle Salmon-Chamberlain, Middle Salmon - Panther, Pahsimerol, South Fork Salmon, Upper Middle Fork Salmon, Upper Grande Ronde, Upper Salmon, and Wallowa. Areas above Hells Canyon Dam are excluded, along with unnamed “impassable natural falls”. Napias Creek Falls, near Salmon, Idaho, was later named an upstream barrier (64FR57399-57403, October 25, 1999). The Grande Ronde, Imnaha, Salmon, and Tucannon subbasins, and Asotin, Granite, and Sheep Creeks were specifically named in the Critical Habitat Notice.

Spawning and rearing counties mentioned in the Critical Habitat Notice include Union, Umatilla, Wallowa, and Baker counties in Oregon; Adams, Blaine, Custer, Idaho, Lemhi, Lewis, Nez Perce, and Valley counties in Idaho; and Asotin, Columbia, Franklin, Garfield, Walla Walla, and Whitman counties in Washington. However, I have excluded Umatilla and Baker counties in Oregon and Blaine County in Idaho because accessible river reaches are all well above areas where metolachlor can be used. Counties with migratory corridors are all of those down stream from the confluence of the Snake and Columbia Rivers.

Table 33 shows the cropping information for Oregon and Washington counties where the Snake River spring/summer-run chinook salmon ESU occurs. The cropping information for the migratory corridors is the same as for the Snake River fall-run chinook salmon (Table 32). Peas, potatoes, and some corn is grown in spawning and rearing habitat, especially in Whitman, Franklin, Nez Perce, and Latah counties.

Table 33. Crops on which metolachlor can be used in counties which provide spawning and rearing habitat for the Snake River spring/summer run chinook ESU

State	County	Crops	Acres planted
ID	Adams	Corn	104
ID	Idaho	Peas Corn	1,517 117
ID	Nez Perce	Peas Beans	27,475 4,561
ID	Custer	Potatoes	507
ID	Lemhi		0
ID	Valley	Potatoes	225
ID	Lewis	Peas	8,434
ID	Latah	Peas Beans	25,651 1,135
WA	Asotin		0
WA	Garfield		0
WA	Columbia	Peas Corn	6,401 51
WA	Whitman	Peas Beans Corn	89,945 1,283 101

State	County	Crops	Acres planted
WA	Franklin	Potatoes Corn Beans Peas Lima beans	35,770 12,594 2,706 1,096 998
OR	Wallowa		0
OR	Union	Potatoes Beans Peas	660 661 390

We conclude that metolachlor may affect the Snake River spring/summer run chinook ESU, because of the extent of crop acreage on which metolachlor might be applied and its possible adverse effects on aquatic plant cover. However, no data are available on how many acres are actually treated or how many pounds of metolachlor are applied in this ESU. Because the migration corridors consist of larger, faster-flowing streams, impacts on aquatic-plant cover seem unlikely where chinook migrate. We recommend requiring a buffer to minimize runoff and drift into surface waters. Alternatively, allowing only preplant incorporated application for corn and pod crops would reduce runoff and potential exposure of aquatic plants in most counties, except Franklin Co. if metolachlor is used there on potatoes. The Washington State Department of Agriculture's task force also may provide more focused protective measures that would be acceptable.

4. Central Valley Spring-run Chinook Salmon ESU

The Central valley Spring-run chinook salmon ESU was proposed as threatened in 1998 (63FR11482-11520, March 9, 1998) and listed on September 16, 1999 (64FR50393-50415). Critical habitat was designated February 16, 2000 (65FR7764-7787) to encompass all river reaches accessible to listed chinook salmon in the Sacramento River and its tributaries in California, along with the down stream river reaches into San Francisco Bay, north of the Oakland Bay Bridge, and to the Golden Gate Bridge

Hydrologic units and upstream barriers within this ESU are the Sacramento-Lower Cow-Lower Clear, Lower Cottonwood, Sacramento-Lower Thomes (upstream barrier - Black Butte Dam), Sacramento-Stone Corral, Lower Butte (upstream barrier - Centerville Dam), Lower Feather (upstream barrier - Oroville Dam), Lower Yuba, Lower Bear (upstream barrier - Camp Far West Dam), Lower Sacramento, Sacramento-Upper Clear (upstream barriers - Keswick Dam, Whiskeytown dam), Upper Elder-Upper Thomes, Upper Cow-Battle, Mill-Big Chico, Upper Butte, Upper Yuba (upstream barrier - Englebright Dam), Suisin Bay, San Pablo Bay, and San Francisco Bay. These areas are said to be in the counties of Shasta, Tehama, Butte, Glenn, Colusa, Sutter, Yolo, Yuba, Placer, Sacramento, Solano, Nevada, Contra Costa, Napa, Alameda, Marin, Sonoma, San Mateo, and San Francisco. However, with San Mateo County being well south of the Oakland Bay Bridge, it is difficult to see why this county was included.

Table 34 contains usage information for the California counties supporting the Central Valley spring-run chinook salmon ESU. Metolachlor was mostly used in Colusa and Sutter counties in 2001 in this ESU.

Table 34. Use of metolachlor in counties with the Central Valley spring run chinook salmon ESU

County	Crop(s)	Metolachlor usage (lb ai)	Acres treated
Alameda		0	0
Butte	Beans Corn	398 160	274 50
Colusa	Cotton Tomato Corn Beans	4,117 1,945 286 171	3,280 2,410 140 90
Contra Costa	Soil fumigation/preplant (crops not specified)	52	52
Glenn	Corn Beans	1,000 73	485 57
Marin		0	0
Napa		0	0
Nevada		0	0
Placer	Corn	507	401
Sacramento	Beans Landscape maintenance Corn	139 115 95	70 nr 48
San Mateo	Beans Peas	2 5	1 2
San Francisco		0	0
Shasta		0	0
Solano		0	0

County	Crop(s)	Metolachlor usage (lb ai)	Acres treated
Sonoma		0	0
Sutter	Tomato Corn Beans	2,805 553 251	4,147 289 241
Tehama	Beans Corn Uncultivated ag.	403 131 19	319 76 10
Yolo	Corn	184	116
Yuba	Corn	238	167

We conclude that metolachlor may affect, but is not likely to adversely affect, the Central Valley spring run chinook salmon ESU, because of possible adverse effects on aquatic plant cover. However, with the phase-out of metolachlor in California, use likely decreased in 2002 and will continue to decrease as existing stocks are depleted. Therefore, mitigation may not be necessary for this ESU.

5. California Coastal Chinook Salmon ESU

The California coastal chinook salmon ESU was proposed as threatened in 1998 (63FR11482-11520, March 9, 1998) and listed on September 16, 1999 (64FR50393-50415). Critical habitat was designated February 16, 2000 (65FR7764-7787) to encompass all river reaches and estuarine areas accessible to listed chinook salmon from Redwood Creek (Humboldt County, California) to the Russian River (Sonoma County, California), inclusive.

The hydrologic units and upstream barriers are Mad-Redwood, Upper Eel (upstream barrier - Scott Dam), Middle Fort Eel, Lower Eel, South Fork Eel, Mattole, Big-Navarro-Garcia, Gualala-Salmon, Russian (upstream barriers - Coyote Dam; Warm Springs Dam), and Bodega Bay. Counties with agricultural areas where metolachlor could be used are Humboldt, Trinity, Mendocino, Lake, Sonoma, and Marin. A small portion of Glenn County is also included in the Critical Habitat, but metolachlor would not be used in the forested upper elevation areas.

Table 35 contains usage information for the California counties supporting the California coastal chinook salmon ESU. The only county in which metolachlor was used in 2001 was Humboldt Co., but only 80 acres were treated outdoors.

Table 35. Use of metolachlor in counties within the California coastal chinook salmon ESU

County	Crop(s)	Metolachlor usage (lb ai)	Acres treated
Humboldt	Outdoor flowers Greenhouse flowers	157 24	80 63
Mendocino		0	0
Sonoma		0	0
Marin		0	0
Trinity		0	0
Lake		0	0

We conclude that metolachlor has no effect on the California coastal chinook salmon ESU, because of the low amount of metolachlor used and the phase-out of metolachlor in California that will eliminate all use in this ESU.

6. Puget Sound Chinook Salmon ESU

The Puget Sound chinook salmon ESU was proposed as threatened in 1998 (63FR11482-11520, March 9, 1998) and listed a year later (64FR14308-14328, March 24, 1999). Critical habitat was designated February 16, 2000 (65FR7764-7787) to encompass all marine, estuarine, and river reaches accessible to listed chinook salmon in Puget Sound and its tributaries, extending out to the Pacific Ocean.

The hydrologic units and upstream barriers are the Strait of Georgia, San Juan Islands, Nooksack, Upper Skagit, Sauk, Lower Skagit, Stillaguamish, Skykomish, Snoqualmie (upstream barrier - Tolt Dam), Snohomish, Lake Washington (upstream barrier - Landsburg Diversion), Duwamish, Puyallup, Nisqually (upstream barrier - Alder Dam), Deschutes, Skokomish, Hood Canal, Puget Sound, Dungeness-Elwha (upstream barrier - Elwha Dam). Affected counties in Washington, apparently all of which could have spawning and rearing habitat, are Skagit, Whatcom, San Juan, Island, Snohomish, King, Pierce, Thurston, Lewis, Grays Harbor, Mason, Clallam, Jefferson, and Kitsap.

Table 36 shows the cropping information for Washington counties where the Puget Sound chinook salmon ESU is located. Most potential use of metolachlor is on corn, peas, and potatoes in Skagit, Whatcom, and Snohomish counties.

Table 36. Crops and acreage where metolachlor can be used in counties within the Critical Habitat of the Puget Sound chinook salmon ESU

State	County	Crops	Acres planted
WA	Skagit	Peas Potatoes Corn	10,908 6,948 6,681
WA	Whatcom	Corn Potatoes	15,118 1,585
WA	San Juan		0
WA	Island	Corn	850
WA	Snohomish	Corn Peas Snap beans	3,758 3,361 10
WA	King	Corn	770
WA	Pierce	Snap beans Corn	200 358
WA	Thurston		0
WA	Lewis	Peas Corn	1,635 746
WA	Grays Harbor	Peas Corn	1,143 679
WA	Mason		0
WA	Clallam	Corn	79
WA	Jefferson		0
WA	Kitsap		0

We conclude that metolachlor may affect the Critical Habitat of the Puget Sound chinook salmon ESU, because of the extent of crop acreage on which metolachlor might be applied and its possible adverse effects on aquatic plant cover. However, no data are available on how many acres are actually treated or how many pounds of metolachlor are applied in this ESU. We recommend requiring a buffer to minimize runoff and drift into surface waters. Alternatively, allowing only preplant incorporated application for corn and pod crops would reduce runoff and potential exposure of aquatic plants in most counties, but not in Skagit or Whatcom if metolachlor is used there on potatoes. The Washington State Department of Agriculture's task force also may provide more focused protective measures that would be acceptable.

7. Lower Columbia River Chinook Salmon ESU

The Lower Columbia River chinook salmon ESU was proposed as threatened in 1998 (63FR11482-11520, March 9, 1998) and listed a year later (64FR14308-14328, March 24, 1999). Critical habitat was designated February 16, 2000 (65FR7764-7787) to encompass all river reaches accessible to listed chinook salmon in Columbia River tributaries between the Grays and White Salmon Rivers in Washington and the Willamette and Hood Rivers in Oregon, inclusive, along with the lower Columbia River reaches to the Pacific Ocean.

The hydrologic units and upstream barriers are the Middle Columbia-Hood (upstream barriers - Condit Dam, The Dalles Dam), Lower Columbia-Sandy (upstream barrier - Bull Run Dam 2), Lewis (upstream barrier - Merlin Dam), Lower Columbia-Clatskanie, Upper Cowlitz, Lower Cowlitz, Lower Columbia, Clackamas, and the Lower Willamette. Spawning and rearing habitat would be in the counties of Hood River, Wasco, Columbia, Clackamas, Marion, Multnomah, and Washington in Oregon, and Klickitat, Skamania, Clark, Cowlitz, Lewis, Wahkiakum, Pacific, Yakima, and Pierce in Washington. Clatsop County appears to be the only county in the critical habitat that does not contain spawning and rearing habitat, although there is only a small part of Marion County that is included as critical habitat. We have excluded Pierce County, Washington because the very small part of the Cowlitz River watershed in this county is at a high elevation where metolachlor would not be used.

Table 37 shows the cropping information for Oregon and Washington counties where the Lower Columbia River chinook salmon ESU occurs. Metolachlor is potentially used on peas, corn, and beans in several counties, especially Marion and Washington but also Clark, Lewis, and Multnomah.

Table 36. Crops and acreage where metolachlor can be used in counties that are in the Critical Habitat of the Lower Columbia River chinook salmon ESU

State	County	Crops	Acres planted
OR	Wasco		0
OR	Hood River		0
OR	Marion	Beans Corn Peas Lima beans	12,101 2,158 686 115

State	County	Crops	Acres planted
OR	Clackamas	Corn Beans Peas	735 337 104
OR	Multnomah	Corn Peas Beans	1,405 616 77
OR	Washington	Corn Beans Peas	3,193 988 840
OR	Columbia	Corn	48
OR	Clatsop	Corn	5
WA	Pacific		0
WA	Wahkiakum		0
WA	Clark	Corn	1,817
WA	Cowlitz	Peas Corn	771 460
WA	Lewis	Peas Corn	1,635 746
WA	Klickitat		0
WA	Skamania		0

We conclude that metolachlor may affect the critical habitat of the Lower Columbia River chinook ESU, because of the extent of crop acreage on which metolachlor might be applied and its possible adverse effects on aquatic plant cover. However, no data are available on how many acres are actually treated or how many pounds of metolachlor are applied in this ESU. We recommend requiring a buffer to minimize runoff and drift into surface waters. Alternatively, allowing only preplant incorporated application for corn and pod crops would reduce runoff and potential exposure of aquatic plants. The Washington State Department of Agriculture's task force also may provide more focused protective measures that would be acceptable.

8. Upper Willamette River Chinook Salmon ESU

The Upper Willamette River Chinook Salmon ESU was proposed as threatened in 1998 (63FR11482-11520, March 9, 1998) and listed a year later (64FR14308-14328, March 24, 1999). Critical habitat was designated February 16, 2000 (65FR7764-7787) to encompass all river reaches accessible to listed chinook salmon in the Clackamas River and the Willamette River and its tributaries above Willamette Falls, in addition to all down stream river reaches of the Willamette and Columbia Rivers to the Pacific Ocean.

The hydrologic units included are the Lower Columbia-Sandy, Lower Columbia-Clatskanie, Lower Columbia, Middle Fork Willamette, Coast Fork Willamette (upstream barriers - Cottage Grove Dam, Dorena Dam), Upper Willamette (upstream barrier - Fern Ridge Dam), McKenzie (upstream barrier - Blue River Dam), North Santiam (upstream barrier - Big Cliff Dam), South Santiam (upstream barrier - Green Peter Dam), Middle Willamette, Yamhill, Molalla-Pudding, Tualatin, Clackamas, and Lower Willamette. Spawning and rearing habitat is in the Oregon counties of Clackamas, Douglas, Lane, Benton, Lincoln, Linn, Polk, Marion, Yamhill, Washington, and Tillamook. However, Lincoln and Tillamook counties include salmon habitat only in the forested parts of the coast range where metolachlor would not be used. Salmon habitat for this ESU is exceedingly limited in Douglas County also, but we cannot rule out future metolachlor use in Douglas County.

Tables 38 and 39 show the cropping information for Oregon counties where the Upper Willamette River chinook salmon ESU occurs and for the Oregon and Washington counties where this ESU migrates. Beans and corn are grown in most counties, but especially Marion Co.

Table 38. Crops on which metolachlor can be used that are part of the spawning and rearing habitat of the Upper Willamette River chinook salmon ESU

State	County	Crops	Acres planted
OR	Douglas	Beans	19
OR	Lane	Snap beans Corn Potatoes	1,796 500 9
OR	Benton	Beans Corn	3,080 525
OR	Linn	Snap beans Corn	2,688 1,976
OR	Polk	Corn Beans	1,472 598

State	County	Crops	Acres planted
OR	Clackamas	Corn Beans Peas	735 337 104
OR	Marion	Beans Corn Peas Lima beans	12,101 2,158 686 115
OR	Yamhill	Corn Beans	2,173 1,838
OR	Washington	Corn Beans Peas	3,193 988 840

Table 39. Crops on which metolachlor can be used that are part of the migration corridors of the Upper Willamette River chinook salmon ESU

State	County	Crops	Acres planted
WA	Clark	Corn	1,817
WA	Cowlitz	Peas Corn	771 460
WA	Wahkiakum		0
WA	Pacific		0
OR	Multnomah	Corn Peas Beans	1,405 616 77
OR	Columbia	Corn	48
OR	Clatsop	Corn	5

We conclude that metolachlor may affect the Upper Willamette River chinook ESU in spawning and rearing habitat, because of the extent of crop acreage on which metolachlor might be applied and its possible adverse effects on aquatic plant cover. However, no data are available on how many acres are actually treated or how many pounds of metolachlor are applied in this ESU. Because the migration corridors consist of larger, faster-flowing streams, impacts on aquatic-plant cover seem unlikely where chinook migrate. We recommend requiring a buffer to minimize runoff and drift into surface waters. Alternatively, allowing only preplant incorporated application for corn and pod crops would reduce runoff and potential exposure of aquatic plants.

9. Upper Columbia River Spring-run Chinook Salmon ESU

The Upper Columbia River Spring-run Chinook Salmon ESU was proposed as endangered in 1998 (63FR11482-11520, March 9, 1998) and listed a year later (64FR14308-14328, March 24, 1999). Critical habitat was designated February 16, 2000 (65FR7764-7787) to encompass all river reaches accessible to listed chinook salmon in Columbia River tributaries upstream of the Rock Island Dam and downstream of Chief Joseph Dam in Washington, excluding the Okanogan River, as well as all down stream migratory corridors to the Pacific Ocean. Hydrologic units and their upstream barriers are Chief Joseph (Chief Joseph Dam), Similkameen, Methow, Upper Columbia-Entiat, Wenatchee, Upper Columbia-Priest Rapids, Middle Columbia-Lake Wallula, Middle Columbia-Hood, Lower Columbia-Sandy, Lower Columbia-Clatskanie, Lower Columbia, and Lower Willamette. Counties in which spawning and rearing occur are Chelan, Douglas, Okanogan, Grant, Kittitas, and Benton (Table 31), with the lower river reaches being migratory corridors (Table 32).

Tables 40 and 41 present cropping information for those Washington counties that support the Upper Columbia River chinook salmon ESU and for Oregon and Washington counties where this ESU migrates. Grant and Benton counties grow the most acreage of crops potentially treated with metolachlor in the spawning and rearing habitat.

Table 40. Crops on which metolachlor can be used in Washington counties where there is spawning and rearing habitat for the Upper Columbia River chinook salmon ESU

State	County	Crop	Acres planted
WA	Benton	Potatoes Corn	25,317 357
WA	Kittitas	Potatoes Corn	442 110
WA	Chelan		0
WA	Douglas		0
WA	Okanogan		0
WA	Grant	Corn Peas Beans Lima bean	35,123 19,602 18,024 3,878

Table 41. Crops on which metolachlor can be used that are migration corridors for the Upper Columbia River chinook salmon ESU

State	County	Crops	Acres planted
WA	Franklin	Potatoes Corn Beans Peas Lima beans	35,770 12,594 2,706 1,096 998
WA	Yakima	Corn Beans Potatoes Peas Lima beans	24,053 2,251 1,929 1,745 731
WA	Walla Walla	Peas Corn Beans Lima beans	16,658 7,066 5,707 458
WA	Klickitat		0
WA	Skamania		0
WA	Clark	Corn	1,817
WA	Cowlitz	Peas Corn	771 460
WA	Wahkiakum		0
WA	Pacific		0
OR	Gilliam		0
OR	Umatilla	Peas Corn Beans Lima beans	31,187 7,903 2,088 1,239
OR	Sherman		0
OR	Morrow	Potatoes Corn Peas	17,030 9,276 729
OR	Wasco		0

State	County	Crops	Acres planted
OR	Hood River		0
OR	Multnomah	Corn Peas Beans	1,405 616 77
OR	Columbia	Corn	48
OR	Clatsop	Corn	5

We conclude that metolachlor may affect the Upper Columbia River chinook ESU in spawning and rearing habitat, because of the extent of crop acreage on which metolachlor might be applied in Benton and Grant counties and its possible adverse effects on aquatic plant cover. However, no data are available on how many acres are actually treated or how many pounds of metolachlor are applied in this ESU. Because the migration corridors consist of larger, faster-flowing streams, impacts on aquatic-plant cover seem unlikely where chinook migrate. We recommend requiring a buffer to minimize runoff and drift into surface waters. Alternatively, allowing only preplant incorporated application for corn and pod crops would reduce runoff and potential exposure of aquatic plants, except in Benton Co. if metolachlor is used there on potatoes. The Washington State Department of Agriculture's task force also may provide more focused protective measures that would be acceptable.

C. Coho Salmon

Coho salmon, *Oncorhynchus kisutch*, were historically distributed throughout the North Pacific Ocean from central California to Point Hope, AK, through the Aleutian Islands into Asia. Historically, this species probably inhabited most coastal streams in Washington, Oregon, and central and northern California. Some populations may once have migrated hundreds of miles inland to spawn in tributaries of the upper Columbia River in Washington and the Snake River in Idaho.

Coho salmon generally exhibit a relatively simple, 3 year life cycle. Adults typically begin their freshwater spawning migration in the late summer and fall, spawn by mid-winter, then die. Southern populations are somewhat later and spend much less time in the river prior to spawning than do northern coho. Homing fidelity in coho salmon is generally strong; however their small tributary habitats experience relatively frequent, temporary blockages, and there are a number of examples in which coho salmon have rapidly recolonized vacant habitat that had only recently become accessible to anadromous fish.

After spawning in late fall and early winter, eggs incubate in redds for 1.5 to 4 months, depending upon the temperature, before hatching as alevins. Following yolk sac absorption, alevins emerge and begin actively feeding as fry. Juveniles rear in fresh water for up to 15 months, then migrate to the ocean as ‘‘smolts’’ in the spring. Coho salmon typically spend two growing seasons in the ocean before returning to their natal stream. They are most frequently recovered from ocean waters in the vicinity of their spawning streams, with a minority being recovered at adjacent coastal areas, decreasing in number with distance from the natal streams. However, those coho released from Puget Sound, Hood Canal, and the Strait of Juan de Fuca are caught at high levels in Puget Sound, an area not entered by coho salmon from other areas.

1. Central California Coast Coho Salmon ESU

The Central California Coast Coho Salmon ESU includes all coho naturally reproduced in streams between Punta Gorda, Humboldt County, CA and San Lorenzo River, Santa Cruz County, CA, inclusive. This ESU was proposed in 1995 (60FR38011-38030, July 25, 1995) and listed as threatened, with critical habitat designated, on May 5, 1999 (64FR24049-24062). Critical habitat consists of accessible reaches along the coast, including Arroyo Corte Madera Del Presidio and Corte Madera Creek, tributaries to San Francisco Bay.

Hydrologic units within the boundaries of this ESU are: San Lorenzo-Soquel (upstream barrier - Newell Dam), San Francisco Coastal South, San Pablo Bay (upstream barrier - Phoenix Dam- Phoenix Lake), Tomales-Drake Bays (upstream barriers - Peters Dam-Kent Lake; Seeger Dam-Nicasio Reservoir), Bodega Bay, Russian (upstream barriers - Warm springs dam-Lake Sonoma; Coyote Dam-Lake Mendocino), Gualala-Salmon, and Big-Navarro-Garcia. California counties included are Santa Cruz, San Mateo, Marin, Napa, Sonoma, and Mendocino.

Table 42 contains usage information for the California counties supporting the Central California coast coho salmon ESU. Only three acres of crop was treated in this ESU in 2001.

Table 42. Use of metolachlor in counties with the Central California Coast coho ESU

County	Crop(s)	Metolachlor usage (lb ai)	Acres treated
Santa Cruz		0	0
San Mateo	Beans Peas	2 5	1 2
Marin		0	0
Sonoma		0	0
Mendocino		0	0
Napa		0	0

We conclude that there is no effect of metolachlor on the Central California Coast coho ESU, because only three acres were treated in 2001 and metolachlor is being phased-out in California.

2. Southern Oregon/Northern California Coast Coho Salmon ESU

The Southern Oregon/Northern California coastal coho salmon ESU was proposed as threatened in 1995 (60FR38011-38030, July 25, 1995) and listed on May 6, 1997 (62FR24588-24609). Critical habitat was proposed later that year (62FR62741-62751, November 25, 1997) and finally designated on May 5, 1999 (64FR24049-24062) to encompass accessible reaches of all rivers (including estuarine areas and tributaries) between the Mattole River in California and the Elk River in Oregon, inclusive.

The Southern Oregon/Northern California Coast coho salmon ESU occurs between Punta Gorda, Humboldt County, California and Cape Blanco, Curry County, Oregon. Major basins with this salmon ESU are the Rogue, Klamath, Trinity, and Eel river basins, while the Elk River, Oregon, and the Smith and Mad Rivers, and Redwood Creek, California are smaller basins within the range. Hydrologic units and the upstream barriers are Mattole, South Fork Eel, Lower Eel, Middle Fork Eel, Upper Eel (upstream barrier - Scott Dam-Lake Pillsbury), Mad-Redwood, Smith, South Fork Trinity, Trinity (upstream barrier - Lewiston Dam-Lewiston Reservoir), Salmon, Lower Klamath, Scott, Shasta (upstream barrier - Dwinnell Dam-Dwinnell Reservoir), Upper Klamath (upstream barrier - Irongate Dam-Irongate Reservoir), Chetco, Illinois (upstream barrier - Selmac Dam-Lake Selmac), Lower Rogue, Applegate (upstream barrier - Applegate Dam-Applegate Reservoir), Middle Rogue (upstream barrier - Emigrant Lake Dam-Emigrant Lake), Upper Rogue (upstream barriers - Agate Lake Dam-Agate Lake; Fish Lake Dam-Fish Lake; Willow Lake Dam-Willow Lake; Lost Creek Dam-Lost Creek Reservoir), and Sixes. Related counties are Humboldt, Mendocino, Trinity, Glenn, Lake, Del Norte, Siskiyou in California and Curry, Jackson, Josephine, Klamath, and Douglas, in Oregon. However, I have excluded Glenn County, California from this analysis because the salmon habitat in this county is not near the agricultural areas where metolachlor can be used.

Only 173 acres were treated with metolachlor in 2001 in the California counties supporting the Southern Oregon/Northern California coastal coho salmon ESU (Table 43). In the Southern Oregon/Northern California coastal coho salmon ESU, almost 9,000 acres of potatoes are grown in Klamath Co., Oregon (Table 44).

Table 43. Use of metolachlor in California counties within the Southern Oregon/Northern California coastal coho salmon ESU

County	Crop(s)	Metolachlor usage (lb ai)	Acres treated
Humboldt	Outdoor flowers	157	80
	Greenhouse flowers	24	63

Mendocino		0	0
Del Norte	Outdoor flowers	67	34
Siskiyou		0	0
Trinity		0	0
Lake		0	0

Table 44. Metolachlor use in Oregon counties where there is habitat for the Southern Oregon/Northern California coastal coho salmon ESU

State	County	Crops	Acres planted
OR	Curry		0
OR	Jackson	Corn	247
OR	Josephine		0
OR	Douglas	Beans	19
OR	Klamath	Potatoes	8,951

We conclude that metolachlor may affect the Southern Oregon/Northern California coastal coho salmon ESU, but only because of the extent of crop acreage of potatoes grown in Klamath Co., Oregon. However, no data are available on how many acres are actually treated or how many pounds of metolachlor are applied in this county. We recommend requiring a buffer to minimize runoff and drift into surface waters.

3. Oregon Coast coho salmon ESU

The Oregon coast coho salmon ESU was first proposed for listing as threatened in 1995 (60FR38011-38030, July 25, 1995), and listed several years later 63FR42587-42591, August 10, 1998). Critical habitat was proposed in 1999 (64FR24998-25007, May 10, 1999) and designated on February 16, 2000 (65FR7764-7787).

This ESU includes coastal populations of coho salmon from Cape Blanco, Curry County, Oregon to the Columbia River. Spawning is spread over many basins, large and small, with higher numbers further south where the coastal lake systems (e.g., the Tenmile, Tahkenitch, and Siltcoos basins) and the Coos and Coquille Rivers have been particularly productive. Critical Habitat includes all accessible reaches in the coastal hydrologic reaches Necanicum, Nehalem, Wilson-Trask-Nestucca (upstream barrier - McGuire Dam), Siletz-Yaquina, Alsea, Siuslaw, Siltcoos, North Umpqua (upstream barriers - Cooper Creek Dam, Soda Springs Dam), South

Umpqua (upstream barrier - Ben Irving Dam, Galesville Dam, Win Walker Reservoir), Umpqua, Coos (upstream barrier - Lower Pony Creek Dam), Coquille, Sixes. Related Oregon counties are Douglas, Lane, Coos, Curry, Benton, Lincoln, Polk, Tillamook, Yamhill, Washington, Columbia, Clatsop. However, the portions of Yamhill, Washington, and Columbia counties that are within the ESU do not include agricultural areas where metolachlor can be used, and I have eliminated them in this analysis.

Table 45 shows the cropping information for Oregon counties where the Oregon coast coho salmon ESU occurs. The greatest potential use of metolachlor here is on potatoes in Benton Co.

Table 45. Crops on which metolachlor can be used that are in counties where there is habitat for the Oregon coast coho salmon ESU

State	County	Crops	Acres planted
OR	Curry		0
OR	Coos	Corn	203
OR	Douglas	Beans	19
OR	Lane	Snap beans Corn Potatoes	1,796 500 9
OR	Lincoln		0
OR	Benton	Potatoes Corn	25,317 357
OR	Polk	Corn Beans	1,472 598
OR	Tillamook		0
OR	Clatsop	Corn	5

We conclude that metolachlor may affect the Oregon coast coho salmon ESU, because of the extent of crop acreage, especially corn in Benton Co., Oregon, on which metolachlor might be applied and its possible adverse effects on aquatic plant cover. However, no data are available on how many acres are actually treated or how many pounds of metolachlor are applied in this ESU. We recommend requiring a buffer to minimize runoff and drift into surface waters.

D. Chum Salmon

Chum salmon, *Oncorhynchus keta*, have the widest natural geographic and spawning distribution of any Pacific salmonid, primarily because its range extends farther along the shores of the Arctic Ocean. Chum salmon have been documented to spawn from Asia around the rim of the North Pacific Ocean to Monterey Bay in central California. Presently, major spawning populations are found only as far south as Tillamook Bay on the northern Oregon coast.

Most chum salmon mature between 3 and 5 years of age, usually 4 years, with younger fish being more predominant in southern parts of their range. Chum salmon usually spawn in

coastal areas, typically within 100 km of the ocean where they do not have surmount river blockages and falls. However, in the Skagit River, Washington, they migrate at least 170 km.

During the spawning migration, adult chum salmon enter natal river systems from June to March, depending on characteristics of the population or geographic location. . In Washington, a variety of seasonal runs are recognized, including summer, fall, and winter populations. Fall-run fish predominate, but summer runs are found in Hood Canal, the Strait of Juan de Fuca, and in southern Puget Sound, and two rivers in southern Puget Sound have winter-run fish.

Redds are usually dug in the mainstem or in side channels of rivers. Juveniles outmigrate to seawater almost immediately after emerging from the gravel that covers their redds. This means that survival and growth in juvenile chum salmon depend less on freshwater conditions than on favorable estuarine and marine conditions.

<u>1. Hood Canal Summer-run chum salmon ESU</u>

The Hood Canal summer-run chum salmon ESU was proposed for listing as threatened, and critical habitat was proposed, in 1998 (63FR11774-11795, March 10, 1998). The final listing was published a year later (63FR14508-14517, March 25, 1999), and critical habitat was designated in 2000 (65FR7764-7787).

Critical habitat for the Hood Canal ESU includes Hood Canal, Admiralty Inlet, and the straits of Juan de Fuca, along with all river reaches accessible to listed chum salmon draining into Hood Canal as well as Olympic Peninsula rivers between Hood Canal and Dungeness Bay, Washington. The hydrologic units are Skokomish (upstream boundary - Cushman Dam), Hood Canal, Puget Sound, Dungeness-Elwha, in the counties of Mason, Clallam, Jefferson, Kitsap, and Island.

Streams specifically mentioned, in addition to Hood Canal, in the proposed critical habitat Notice include Union River, Tahuya River, Big Quilcene River, Big Beef Creek, Anderson Creek, Dewatto River, Snow Creek, Salmon Creek, Jimmycomelately Creek, Duckabush ‘stream’, Hamma Hamma ‘stream’, and Dosewallips ‘stream’.

Tables 46 shows the cropping information for Washington counties where the Hood Canal summer-run chum salmon ESU occurs.

Table 46. Crops on which metolachlor can be used that are in counties where there is habitat for the Hood Canal Summer-run chum salmon ESU

State	County	Crops	Acres planted
WA	Mason		0
WA	Clallam	Corn	79
WA	Jefferson		0
WA	Kitsap		0
WA	Island	Corn	850

We conclude that metolachlor will have no effect on the Hood Canal Summer-run chum salmon ESU, because so little crop is potentially treated in these counties.

2. Columbia River Chum Salmon ESU

The Columbia River chum salmon ESU was proposed for listing as threatened, and critical habitat was proposed, in 1998 (63FR11774-11795, March 10, 1998). The final listing was published a year later (63FR14508-14517, March 25, 1999), and critical habitat was designated in 2000 (65FR7764-7787).

Critical habitat for the Columbia River chum salmon ESU encompasses all accessible reaches and adjacent riparian zones of the Columbia River (including estuarine areas and tributaries) downstream from Bonneville Dam, excluding Oregon tributaries upstream of Milton Creek at river km 144 near the town of St. Helens. These areas are the hydrologic units of Lower Columbia - Sandy (upstream barrier - Bonneville Dam, Lewis (upstream barrier - Merlin Dam), Lower Columbia - Clatskanie, Lower Cowlitz, Lower Columbia, Lower Willamette in the counties of Clark, Skamania, Cowlitz, Wahkiakum, Pacific, Lewis, Washington and Multnomah, Clatsop, Columbia, and Washington, Oregon. It appears that there are three extant populations in Grays River, Hardy Creek, and Hamilton Creek.

Table 47 shows the cropping information for Oregon and Washington counties where the Columbia River chum salmon ESU occurs.

Table 47. Crops on which metolachlor can be used that are in counties where there is habitat for the Columbia River chum salmon ESU

State	County	Crops	Acres planted
WA	Skamania		0
WA	Clark	Corn	1,817
WA	Lewis	Peas Corn	1,635 746
WA	Cowlitz	Peas Corn	771 460
WA	Pacific		0
WA	Wahkiakum		0
OR	Multnomah	Corn Peas Beans	1,405 616 77
OR	Columbia	Corn	48
OR	Washington	Corn Beans Peas	3,193 988 840
OR	Clatsop	Corn	5

We conclude that metolachlor may affect the Columbia River chum salmon ESU, because of the extent of crop acreage on which metolachlor might be applied and its possible adverse effects on aquatic plant cover. However, no data are available on how many acres are actually treated or how many pounds of metolachlor are applied in this ESU. We recommend requiring a buffer to minimize runoff and drift into surface waters. Alternatively, allowing only preplant incorporated application for corn and pod crops would reduce runoff and potential exposure of aquatic plants. The Washington State Department of Agriculture's task force also may provide more focused protective measures that would be acceptable.

E. Sockeye Salmon

Sockeye salmon, *Oncorhynchus nerka*, are the third most abundant species of Pacific salmon, after pink and chum salmon. Sockeye salmon exhibit a wide variety of life history patterns that reflect varying dependency on the fresh water environment. The vast majority of sockeye salmon typically spawn in inlet or outlet tributaries of lakes or along the shoreline of lakes, where their distribution and abundance is closely related to the location of rivers that provide access to the lakes. Some sockeye, known as kokanee, are non-anadromous and have been observed on the spawning grounds together with their anadromous counterparts. Some sockeye, particularly the more northern populations, spawn in mainstem rivers.

Growth is influenced by competition, food supply, water temperature, thermal stratification, and other factors, with lake residence time usually increasing the farther north a nursery lake is located. In Washington and British Columbia, lake residence is normally 1 or 2 years. Incubation, fry emergence, spawning, and adult lake entry often involve intricate patterns of adult and juvenile migration and orientation not seen in other *Oncorhynchus* species. Upon emergence from the substrate, lake-type sockeye salmon juveniles move either downstream or upstream to rearing lakes, where the juveniles rear for 1 to 3 years prior to migrating to sea. Smolt migration typically occurs beginning in late April and extending through early July.

Once in the ocean, sockeye salmon feed on copepods, euphausiids, amphipods, crustacean larvae, fish larvae, squid, and pteropods. They will spend from 1 to 4 years in the ocean before returning to freshwater to spawn. Adult sockeye salmon home precisely to their natal stream or lake. River-and sea-type sockeye salmon have higher straying rates within river systems than lake-type sockeye salmon.

1. Ozette Lake Sockeye Salmon ESU

The Ozette Lake sockeye salmon ESU was proposed for listing, along with proposed critical habitat in 1998 (63FR11750-11771, March 10, 1998). It was listed as threatened on March 25, 1999 (64FR14528-14536), and critical habitat was designated on February 16, 2000 (65FR7764-7787). This ESU spawns in Lake Ozette, Clallam County, Washington, as well as in its outlet stream and the tributaries to the lake. It has the smallest distribution of any listed Pacific salmon.

While Lake Ozette, itself, is part of Olympic National Park, its tributaries extend outside park boundaries, much of which is private land. There is limited agriculture in the whole of Clallam County. Metolachlor is potentially used only on a few acres of corn in Clallam Co. (Table 48).

Table 48. Crops on which metolachlor can be used that are in Clallam County where there is habitat for the Ozette Lake sockeye salmon ESU

State	County	Crops	Acres planted
WA	Clallam	Corn	79

We conclude that metolachlor will have no effect on the Ozette Lake sockeye salmon ESU, because little metolachlor is apt to be used on corn in Clallam Co.

2. Snake River Sockeye Salmon ESU

The Snake River sockeye salmon was the first salmon ESU in the Pacific Northwest to be listed. It was proposed and listed in 1991 (56FR14055-14066, April 5, 1991 & 56FR58619-58624, November 20, 1991). Critical habitat was proposed in 1992 (57FR57051-57056, December 2, 1992) and designated a year later (58FR68543-68554, December 28, 1993) to include river reaches of the mainstem Columbia River, Snake River, and Salmon River from its confluence with the outlet of Stanley Lake down stream, along with Alturas Lake Creek, Valley Creek, and Stanley, Redfish, Yellow Belly, Pettit, and Alturas lakes (including their inlet and outlet creeks).

Spawning and rearing habitats are considered to be all of the above-named lakes and creeks, even though at the time of the critical habitat Notice, spawning only still occurred in Redfish Lake. These habitats are in Custer and Blaine counties in Idaho. However, the habitat area for the salmon is high elevation areas in a National Wilderness area and National Forest. Metolachlor cannot be used on such a site, and therefore there will be no exposure in the spawning and rearing habitat. There is a probability that this salmon ESU could be exposed to metolachlor in the lower and larger river reaches during its juvenile or adult migration.

Only a small acreage of potatoes is grown in Custer and Blaine counties encompassing spawning and rearing habitat for the Snake River sockeye salmon ESU (Table 49). Considerably more crop acreage occurs in counties that are in the migratory corridors (Table 50).

Table 49. Crops on which metolachlor can be used that are in Idaho counties where there is spawning and rearing habitat for the Snake River sockeye salmon ESU

State	County	Crops	Acres planted
ID	Custer	Potatoes	507
ID	Blaine	Potatoes	848

Table 50. Crops on which metolachlor can be used in counties within the migratory corridors for the Snake River sockeye salmon ESU

State	County	Crops	Acres planted
ID	Idaho	Peas Corn	1,517 117
ID	Lemhi		0
ID	Lewis	Peas	8,434

State	County	Crops	Acres planted
ID	Nez Perce	Peas Beans	27,475 4,561
WA	Asotin		0
WA	Garfield		0
WA	Whitman	Peas Beans Corn	89,945 1,283 101
WA	Columbia	Peas Corn	6,401 51
WA	Walla Walla	Peas Corn Beans Lima beans	16,658 7,066 5,707 458
WA	Franklin	Potatoes Corn Beans Peas Lima beans	35,770 12,594 2,706 1,096 998
WA	Benton	Potatoes Corn	25,317 357
WA	Klickitat		0
WA	Skamania		0
WA	Clark	Corn	1,817
WA	Cowlitz	Peas Corn	771 460
WA	Wahkiakum		0
WA	Pacific		0
OR	Wallowa		0
OR	Umatilla	Peas Corn Beans Lima beans	31,187 7,903 2,088 1,239

State	County	Crops	Acres planted
OR	Morrow	Potatoes Corn Peas	17,030 9,276 729
OR	Gilliam		0
OR	Sherman		0
OR	Wasco		0
OR	Hood River		0
OR	Multnomah	Corn Peas Beans	1,405 616 77
OR	Columbia	Corn	48
OR	Clatsop	Corn	5

We conclude that metolachlor may affect the Snake River sockeye salmon ESU in spawning and rearing habitat, but only if metolachlor is used on potatoes in Custer and Blaine counties. However, no data are available on how many acres are actually treated or how many pounds of metolachlor are applied in these two counties. We recommend requiring a buffer to minimize runoff and drift into surface waters. Because the migration corridors consist of larger, faster-flowing streams, impacts on aquatic-plant cover seem unlikely where salmon migrate.

5. Summary conclusions for listed Pacific salmon and steelhead

Based on the available information and best professional judgement, our conclusions on potential adverse indirect effects on listed Pacific salmon and steelhead are provided in Table 51. We conclude that metolachlor will have no effect on six ESUs, may affect 15 ESUs, and may affect, but not likely to adversely affect, five ESUs. The may-affect determinations are based on the acreage potentially treated in counties within an ESU and possible adverse effects of metolachlor on aquatic-plant cover.

Table 51. Summary conclusions on specific ESUs of listed Pacific salmon and steelhead for metolachlor

Species	ESU	Finding
Steelhead	Southern California	may affect, but not likely to adversely affect
Steelhead	South-Central California Coast	may affect, but not likely to adversely affect
Steelhead	Central California Coast	may affect, but not likely to adversely affect
Steelhead	Central Valley, California	may affect, but not likely to adversely affect
Steelhead	Northern California	no effect
Steelhead	Upper Columbia River	may affect
Steelhead	Snake River Basin	may affect
Steelhead	Upper Willamette River	may affect
Steelhead	Lower Columbia River	may affect
Steelhead	Middle Columbia River	may affect
Chinook Salmon	Sacramento River winter-run	no effect
Chinook Salmon	Snake River fall-run	may affect
Chinook Salmon	Snake River spring/summer-run	may affect
Chinook Salmon	Central Valley spring-run	may affect, but not likely to adversely affect
Chinook Salmon	California Coastal	no effect
Chinook Salmon	Puget Sound	may affect
Chinook Salmon	Lower Columbia	may affect
Chinook Salmon	Upper Willamette	may affect
Chinook Salmon	Upper Columbia	may affect
Coho salmon	Central California	no effect

Species	ESU	Finding
Coho salmon	Southern Oregon/Northern California Coasts	may affect
Coho salmon	Oregon Coast	may affect
Chum salmon	Hood Canal summer-run	no effect
Chum salmon	Columbia River	may affect
Sockeye salmon	Ozette Lake	no effect
Sockeye salmon	Snake River	may affect

Many factors will affect how much, if any, metolachlor reaches surface waters inhabited by listed Pacific salmon and steelhead. A major factor is proximity of the treatment site to waters potentially receiving drift and runoff. Major concern would be treatment sites located nearby receiving waters used for spawning and rearing. We currently have insufficient information to determine where metolachlor treatment sites are located. This is especially true in Oregon, Washington, and Idaho where the only information available is which crops are grown in counties within the ESUs; however, we do not know how much of those crops are actually treated with metolachlor. In such situations, a buffer could be required to minimize drift and runoff into surface waters. For pod crops and corn, preplant incorporated application is expected to produce considerably less runoff than preemergence (during or after planting but only before weeds or crop emerge) unincorporated application. Therefore, requiring that applications to these crops be incorporated also could be considered in addition or as an alternative to a buffer.

Use of metolachlor on potatoes potentially poses the greatest runoff of metolachlor into surface waters in areas where potato fields are nearby surface waters. Multiple, unincorporated applications can be made, with up to 4.5 lb ai applied per acre per growing season. However, we have no information on the proximity of potato fields to surface waters or how much metolachlor is used on potatoes in Washington, Oregon, and Idaho ESUs. These applications are not incorporated, so we recommend a buffer. The Washington State Department of Agriculture's task force may provide more focused protective measures that would be acceptable.

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